

**Fish Parasites  
Collected at Woods  
Hole in 1898**



LINTON, EDWIN, 1855-1939







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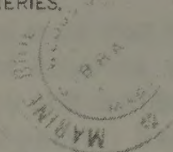
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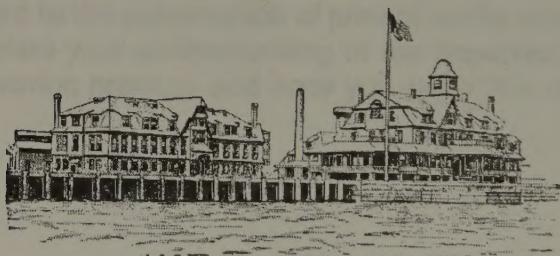
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## FISH PARASITES COLLECTED AT WOODS HOLE IN 1898.

BY

EDWIN LINTON, PH. D.,

*Professor of Biology in Washington and Jefferson College.*



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## FISH PARASITES COLLECTED AT WOODS HOLE IN 1898

By EDWIN LINTON Ph. D.,

Professor of Biology, Washington and Jefferson College

The following report is divided into two parts

In Part I a list of the hosts which were examined, or from which parasites were obtained, is given. In each instance brief mention is made of the parasites found, the dates of examination are given, and where the stomach contents were noted a record is entered. In nearly every case in which no note was made of stomach contents the stomachs were empty.

Adult trematodes and cestodes and a few nematodes have been identified. Many larval cestodes and most of the nematodes have not yet been identified.

The order of arrangement of hosts is substantially that of Dr. H. M. Smith, "The Fishes found in the Vicinity of Woods Hole" (Bulletin of the United States Fish Commission for 1897).

In Part II descriptions are given of new species and of species new to the region. While this report has mainly to do with the entozoa, I have given descriptions of two ectoparasites: (1) A copepod, found in the cheek of a squeteague (*Cynoscion regalis*). (2) A tritremum (*Epibidella bumpusa* sp. nov.), from the skin of a stingray (*Dasyatis centroura*). In the description of the latter are incorporated some observations on the process of egg-making as it was seen in this interesting species.

### PATHOLOGICAL CONDITIONS

It was under consideration to arrange in a third part such cases as might be referred to as pathological or diseased conditions. This proved undesirable, since it would have caused needless repetition. For convenience of reference, however, are here arranged the principal cases where damage, more or less serious, resulted to the tissues of the host from the presence of parasites.

1. Cyst with trematode ova, p. 297, figs. 82-81
2. Immature distoma encysted in the skin of the eunuch, p. 296, figs. 76-81
3. On the occurrence of cysts in the stomach wall of the blue fish, p. 301, fig. 101
4. On cysts in the stomach-wall of the black sea bisk, p. 301, figs. 103, 104

5. Cysts from kidneys of scup, p. 301
6. *Acanthocheilichthys nudifex*, p. 303, fig. 116
7. *Cyprinodon variegatus*, p. 277
8. *Galeocerdo tigrinus* (not due to entozoa), p. 270, fig. 102
9. *Urolophus americana*, p. 279
10. *Calostomus commersonii*, p. 276

In this connection reference may be made to *Tetrakynchus bicolor*, which was found burrowing into the stomach coats of the leopard shark (*Galeocerdo tigrinus*), and to *T. elongatus*, whose extraordinarily long blastocysts appear to be always present in the liver of the sunfish (*Mola mola*). *Dibothrium phricatum* appears to produce more or

less irritation by its attachment to the walls of the rectum of the sword-fish (*Xiphias gladius*), and *Echinorhynchus proteus*, in almost all cases where seen in the squeteague (*Cynoscion regalis*), the blue-fish (*Pomatomus saltatrix*), and in former years in the striped bass (*Morone saxatilis*), penetrates the intestinal wall of its host, causing various degeneration alterations in the surrounding tissues.

## Summary of results (for details see Part I).

Host.  Scientific and common names.	Parasites.					Stomach contents.
	No. examined.	Nematodes.	Acanthocephala.	Trematodes.	Cestodes. Euryated. Froce.	
1. <i>Mustelus canis</i> , Smooth dog-fish.....	10				Few. Many (2 species).	Crabs, Etc.
2. <i>Galeocerdo ligatus</i> , Leopard shark.....	2	Many.			Numerous	Fish, mollusks, etc.
3. <i>Carcharhinus obscurus</i> , Dusky shark.....	4				Numerous (5 species).	Fish.
4. <i>Sphyrna zygaena</i> , Hammerhead shark.....	3	2			Few (2 species).	Fish, squid.
5. <i>Carcharias taurus</i> , Sand shark.....	14				Numerous	Fish.
6. <i>S. maculatus</i> , Spiny dog-fish.....	100	1			Few.	1 Fish.
7. <i>Raja ocellata</i> , Big skate.....	3	1			1	Amphipoda, squid.
8. <i>Raja erinacea</i> , Common skate.....	4	2			1	Crabs, annelids, shrimp, etc.
9. <i>Tetracurus occidentalis</i> , Torpedo.....	5				8	Fish.
10. <i>Dasyatis centroura</i> , Stingray.....	7				Few. Many (11 species).	Crustacea.
11. <i>Myliobatis freminvillei</i> , Sharp-nosed ray.....	1				Numerous (3 species).	Mollusk.
12. <i>Anguilla chrysops</i> , Common eel.....	3	1			Few.	Fish.
13. <i>Clupea harengus</i> , Herring.....	1	1			Few.	Shrimp, copepods, etc.
14. <i>Protomelas tyrannus</i> , Menhaden.....	7	3			Few. Many (larvae).	
15. <i>Uppineodon variegatus</i> , Short mackerel.....	2					
16. <i>Tylosurus marinus</i> , Gar-fish.....	3			1	Numerous (larvae).	Fish.
17. <i>Sardinia sarda</i> , Bontie.....	37			Numerous	Few.	Fish.
18. <i>Scorpaenopsis regalis</i> , Spanish mackerel.....	1			Numerous		Fish.
19. <i>Xiphias gladius</i> , Sword fish.....	2	24			6	Fish, squid.
20. <i>Naturalis dieter</i> , Pilot fish.....	1	1			Numerous	Fish, squid.
21. <i>Pomatomus saltatrix</i> , Blue-fish.....	8	1			Numerous	Scallop, crustacea, mollusks, and squid.
22. <i>Pseudopleuronectes americanus</i> , Tautog-fish.....	14		1	Numerous	Numerous (larvae).	
23. <i>Rhombus triacanthus</i> , Butter-fish.....	9	Numerous			Few.	Shrimp.
24. <i>Morone americana</i> , White perch.....	3			Numerous	Numerous	Fish.
25. <i>Centropristis striata</i> , Black sea bass.....	2	Few.		Few.	Many (larvae).	Hydroids, annelids, crustacea, squid.
26. <i>Stenotomus chrysops</i> , Senp.....	33	Numerous			Few.	Fish.
27. <i>Cynoscion regalis</i> , Squeteague.....	47	Many.	Few.		Many. Numerous (larvae).	Fish.
28. <i>Tautoglabrus adspersus</i> , Gummee.....	22			Very numerous.	Few.	Fish, sea urchins, etc.
29. <i>Spheroideus maculatus</i> , Puffer.....	3		1	Numerous	1	
30. <i>Mola mola</i> , Sea-turtle.....	1			Numerous (4 species).	Few.	
31. <i>Myoxocephalus aeneus</i> , Sculpin.....	1	2				Fish.
32. <i>Prionotus carolinus</i> , Sea robble.....	9	Few.		3		Crabs.
33. <i>Lopholatilus chamaeleonticeps</i> , Tile-fish.....	5					1
34. <i>Opsanus tau</i> , Tautog-fish.....	2	6		Few.	Many.	Fish.
35. <i>Merluccius bilinearis</i> , Silver halibut.....	6	Few.			Numerous (larvae).	
36. <i>Pollachius virens</i> , Pollock.....	1	50		100	Many.	Numerous
37. <i>Paralichthys dentatus</i> , Summer flounder.....	24	Few.	Few.	Few (2 species).	Numerous (larvae).	Squid, fish.
38. <i>Limanda ferruginea</i> , Sand dab.....	1				1	
39. <i>Pseudopleuronectes americanus</i> , Winter flounder.....	3					
40. <i>Lopholatilus chamaeleonticeps</i> , Tile-fish.....	3	Many.	3	11	Numerous	Numerous (larvae).

## List of forms described in Part II

Parasite	Host	Date	Figure
Parasitic copepod ..	<i>Cynoscion regalis</i>	33	1-
<i>Oribolichium dentulatum</i> Olsson	<i>Pollichius virgatus</i>	33	6-10
<i>Pubicella biapinnis</i> sp. nov.	<i>Physalis oculata</i>	34	11-15
<i>Diatomum oculatum</i> Molin	<i>Pollichius virgatus</i>	35	16-24
<i>Diatomum appendiculatum</i> Rudolphi (?)	<i>Pseudolithys dentatus</i>	36	25-26
<i>Diatomum fasciculatum</i> sp. nov.	<i>Lopholatilus chamaeleonticeps</i>	36	27-35
<i>Diatomum vitellinum</i> sp. nov.	<i>Merluccius bilinearis</i>	37	36-39
<i>Diatomum pulchrum</i> sp. nov.	<i>Paralichthys dentatus</i>	37	40-47
<i>Diatomum rubrum</i> sp. nov.	<i>Sphyrna tiburo</i>	38	48-51
<i>Diatomum pygmaeum</i> sp. nov.	<i>Palinurichthys percaratus</i>	38	52-59
<i>Diatomum nitidum</i> Rudolphi (?)	<i>Menidia americana</i>	39	60-61
<i>Diatomum dentatum</i> sp. nov.	<i>Paralichthys dentatus</i>	9	64-67
<i>Diatomum fragile</i> sp. nov.	<i>Mola mola</i>	39	68-70
<i>Diatomum</i> sp.	<i>Prionotus carolinus</i>	39	71
<i>Diatomum</i> sp.	<i>Stenotomus chrysops</i>	39	72
Immature <i>Diatomum</i> encysted in skin of summer	<i>Paralichthys dentatus</i>	40	73-75
Cysts with trematode ova	<i>Tracholabrus alepserus</i>	40	76-81
Cysticostomum ovatum Linton	<i>Merone americanus</i>	40	82-84
Cysticostomum rufum sp. nov.	<i>Lobotes surinamensis</i>	41	85-90
Cysticostomum sp.	<i>Sarda sarda</i>	41	91
Cysticostomum occidentale sp. nov.	<i>Lepidion munitus</i>	41	92-97
<i>Pharyngobothrium</i> sp.	<i>Sphyrna tiburo</i>	42	98-99
<i>Pharyngobothrium</i> sp.	<i>Sarda sarda</i>	42	100
Larval cestode	<i>Pomatomus saltatrix</i>	42	101
Cestode cysts in stomach wall of blue fish	<i>Stenotomus chrysops</i>	42	102-104
Cysts from walleye of spring	<i>Centropomus striatus</i>	43	105-108
Cysts in stomach wall of black sea bass	<i>Pollichius virgatus</i>	43	109-115
<i>Ascaris elyasa</i> Rudolphi	<i>Opsanus tau</i>	43	116-119
<i>Ascaris hiberna</i> sp. nov.	<i>Galeorhinus galeus</i>	43	120-121
<i>Acanthobothrium nudifex</i> sp. nov.	<i>Paralichthys dentatus</i>	43	122-123
<i>Ichthyonema eruginum</i> Rudolphi (?)			

References to my former papers have been inserted in Part I in all cases where forms were identified as belonging to species therein mentioned or described. As a rule, references are made only to record of latest date, and are not repeated under the same host, but are given under the first date on which the species concerning which reference is made was found.

A list of the papers to which references are made is here given for convenience.

- Notes on entozoa of marine fishes of New England. Rept U S I C 1886, pp 453-511, pl I-VI.  
 Notes on entozoa of marine fishes of New England, Part II. Rept U S F C 1887, pp 719-899, pl I-XX.  
 Notes on entozoa of marine fishes of New England. Part III. Rept U S F C 1888, pp 529-542, pl I-III-LVIII.  
 Notes on larval cestode parasites of fishes. Proc U S N M, vol XX (1897), pp 767-824, pl I-XI-LXVIII.  
 Notes on cestode parasites of fishes. Proc U S N M, vol XX (1897), pp 423-456, pl XXXI-XXXIX.  
 Notes on trematode parasites of fishes. Proc U S N M, vol XX (1897), pp 507-518, pl XL-LIV.

The authority for the names of fishes used in this report is The Fishes of North and Middle America, Bulletin U S National Museum, No. 47, Jordan & Evermann.

## PART I.

1. *Mustelus canis*, Dog-fish.

(1) July 20; one, small; stomach with fragments of crabs. *Callinobathrium verticillatum* (Cestode Parasites of Fishes, p. 447, pl. XXXIV, figs. 6, 7) and mature proglottides of *Rhynchobathrium bulbifer* (Cestode Parasites of Fishes, p. 448) in spiral valve.

(2) July 23; one; stomach contents not noted, probably empty. Enormous numbers of *R. bulbifer*, young and adult together, in spiral valve. No other entozoa noted.

(3) July 25; one; crabs in stomach. Degenerate waxy cysts in stomach-wall. *C. verticillatum*, 7, spiral valve. *R. bulbifer*, 23, spiral valve.

(4) July 26; one; stomach contained a partly digested fish, probably a squid, which may have been taken in the pool, where the dog-fish had been confined for a few days. *C. verticillatum*, 2; *R. bulbifer*, 12, in spiral valve.

(5) July 29; two; stomach contents not noted. From the spiral valve of one were obtained 19 *R. bulbifer* and 6 *C. verticillatum*; from the other about 50 *Rhynchobathrium tumidulum*. There was also an unusually large number of small cysts in the stomach-wall. (See Notes on the Larval Cestodes of Fishes, pl. vi, fig. 6.)

(6) July 30; two; stomach contents not noted. In the spiral valve of one there were found 3 *R. bulbifer* and 1 *R. tumidulum*; from the other, 11 *C. verticillatum* and 4 *R. bulbifer*. The second specimen had been in the pool for some time.

(7) August 1; three; stomachs empty. These fish had been in the pool for several days, and had been dead for some time before they were examined. The alimentary canal showed some signs of decomposition. From the spiral valve of the first were obtained 26 specimens of *R. bulbifer*, the scolices still alive and moderately active. From the second 13 specimens of the same species were got and also 2 of *C. verticillatum*. The latter were in poor condition, the anterior segments having disintegrated; the former were in good condition and still active. In the spiral valve of the third were 24 *R. bulbifer* and 10 *C. verticillatum*. These parasites were not attached to the mucous membrane, but were lying loose in the contents of the intestine. It would appear that with the beginning of decomposition the heads soon detach themselves from the walls of the host.

(8) August 12; one; stomach with crabs. Spiral valve contained 12 specimens of *C. verticillatum* and 12 of *R. tumidulum*.

(9) August 19; one; taken from pool and had been dead for some time. Three or four *C. verticillatum* in spiral valve in poor condition.

(10) August 24; one; the specimen had been kept in confinement for a week or more, and had been dead several hours before it was examined. Nothing in stomach except mucus, and no entozoa in alimentary canal.

(11) August 25; three; same conditions as preceding. A few fragments of *R. bulbifer* found in spiral valve, but in poor condition.

It may be concluded from the foregoing examples that entozoa remain living for but a few hours in the intestinal tract after the death of the host. They quickly become flaccid and soon show the effect of the digestive fluids, and later of decomposition. Presumably they require the presence of oxygen in the intestinal blood-vessels, and as soon as this supply is cut off they quickly succumb. When they are placed in normal salt solution while still active they may be kept alive for hours, and by adding a small amount of nutrient material and pepsin will not only live for days but may increase in size.

2. *Galeocerdo tigrinus*, Leopard Shark.

(1) August 11; one; stomach contents were sand, one pod of a string bean, and two tough masses of flesh, mainly coarse fibrous tissue, not identified. The color of these pieces was about that of fresh "sea pork" (*luaracium*), and the structure something like that of the "foot" of the winkie (*Sycotypus*).

Mr. Vinel N. Edwards reported to me the contents of the stomach of another specimen taken on August 12, but not brought into the laboratory, which consisted of a rather curious collection,



namely, one chicken wing with the feathers on it, two slices of beef-steak, a few pieces of cucumber and two large pieces of "salt pork," a piece of rope yarn, partly twisted out, with other debris. Evidently a bucket of waste from the cook's galley of some passing vessel had been thrown overboard, and the shark had scooped up the whole mess.

Large numbers of *Thysancephalum crispum* (Cestode Parasites of Fishes, p. 118), large and small, with enormous numbers of free proglottides in the spiral valve. The scolices were found attached to the mucous membrane. The pseudobothria, in such cases, were expanded into a flat imbricated disk and closely adherent to the mucous membrane. These cestodes were counted and a number of them measured. There were 56 with mature proglottides and 238 young. The latter ranged in length from 30 to 300 mm. The average of 11 representative forms was 128 mm. Strobiles, which had ripe proglottides measured 1.25 meters. This represents an actual total length of something like 100 meters, or, allowing for the maturity of the small specimens, a potential length of 367 meters (approximately  $\frac{1}{2}$  mile), without taking into account the free proglottides, of which there were immense numbers.

*Acanthobutrus nidifer* sp. nov. (see Part II, page 303 for description) in cysts in stomach-wall and free in pylorus.

(2) August 19, one (2.5 meters in length), stomach contained numerous jaws of squid, some of them of good size, various bones, skull of a fish, numerous air bones of fish, the operculum of a mollusk (*Janthin*), seaweed (*Kuwa*), sand and gravel, and a nondescript piece of animal tissue about the size of one's hand, probably the remains of the pectoral fin of a goose-halibut.

Large numbers of *Thysancephalum crispum* seen in every specimen of this shark I have examined, in spiral valve. Also a few small forms not yet identified, heads resembling those of the genus *Spongibothrium*. There is, however, a fleshy anterior median eminence on the head. The worms are small, and before killing exhibited a tendency to become convoluted.

There were also several free proglottides of an altogether different kind from those of *Thysancephalum*, of which, as usual, there were enormous numbers. The eggs of *Thysancephalum* are fusiform in shape, in unemitted form among cestode eggs.

*Acanthymus bicolor* (Linné's Cestode Parasites of Fishes, pp. 813-815, pl. LXXXI, figs. 1-6), 36 specimens, firmly attached to stomach-wall, where they had formed deep pits, extending into the muscular layers. Head and neck white, back of collar yellowish. These specimens, when removed from the host and placed in sea-water, contracted and expanded actively and assumed great variety of shapes.

Two imperfect strobiles without scolices were found in the stomach. Upon sectioning they were found to be identical with sections of *Thysancephalum* and were so identified. I do not know how to account for their presence in the stomach.

*Acanthocephalus nidifer* as in shark examined on August 11.

**Pathological conditions of pylorus of *Galeorhinus gignus*.**—The pylorus of each of the specimens of leopard shark examined was occluded by what appears to be a colloid tumor developed in the submucosa, pl. 12, fig. 102. Although occurring in different places in the two cases they were of the same essential structure in each. A brief description of the first is given. The tumor was first encountered at its anterior end while sitting the pylorus with scissors from the anterior end. It presented a smooth globular stopper-like surface, which apparently completely occluded the lumen of the pylorus. No passage could be found on passing a probe around the periphery of the tumor. On cutting into the lumen at the posterior end of the tumor a narrow passage was discovered, which led back behind the tumor and proved to be continuous with the lumen of the pylorus. This narrow passage diverged from the lumen a short distance in front of the tumor. Two raised folds of epithelium, parallel with each other and lying longitudinal to the axis of the pylorus, led into the passage. The anterior end of the tumor lay 2.5 cm. back of stomach. It was about 9 cm. in length and 2.6 cm. in diameter at its anterior end, its posterior end about 9 cm. in front of the entrance of the bile duct. These dimensions include the mucous membrane, which was pushed into the lumen by the developing tumor. The anterior end was the larger, and the diameter grew gradually less to the posterior end, which terminated in a blunt point. The passage, which remained open, was very narrow, and its epithelium had a different appearance from that of the lumen, both before and behind the tumor.

In the shark examined on August 19 a similar tumor was found about midway of the length of the pylorus, also with a narrow passage beside it. The main lumen was also interrupted at other points. I had no mention of such structures in notes made in former years on examinations of this shark, and have no recollection of seeing anything like them before.



3. *Carcharhinus obscurus*, *Dusky Shark*.

(1) July 18; one; a small skate the only identifiable stomach contents. All the parasites found in this shark were cestodes, as follows:

- Anthobothrium laciniatum* (Cestode Parasites of Fishes, p. 439), numerous, spiral valve.  
*Orgymatobothrium angustum* (Cestode Parasites of Fishes, p. 443), numerous, spiral valve.  
*Phorciobothrium lasium* (Cestode Parasites of Fishes, p. 447), numerous, spiral valve.  
*Tetrarhynchus bisulcatus* (Cestode Parasites of Fishes, p. 452), very numerous, pylorus.

The pyloric portion of the stomach, which was about 46 cm. in length, was crowded throughout its length with *Tetrarhynchus bisulcatus*, of which there were approximately 300 specimens. These worms had their heads deeply embedded in the mucous membrane of the pylorus, several of them often being attached at the same point, the strobiles hanging in a festoon from a common pit in the pylorus wall. The mucous membrane, especially in the vicinity of the pits, was in a highly inflamed condition. It is quite conceivable that these parasites might occasion the death of their host by giving rise to such irritation as to occlude the passage by the consequent swelling of the mucous membrane and underlying tissues. In several places the strobiles themselves were so numerous as to offer serious resistance to the passage of food. These specimens were larger than usual, many of them when straightened, while living, measuring as much as 40 cm.

It would appear from a consideration of the occurrence of these parasites in this case that the most defective part of the alimentary canal of the shark is not the spiral valve but the slender pylorus. This is borne out also in the case of the tiger shark. The three species of cestodes found in the spiral valve, while occurring in great numbers and attaching themselves to the mucous membrane, are small and do not occasion much irritation by their presence.

(2) July 19; one, stomach contained a partly digested squeteague. The shark had been confined in the large pool for a week or more. No parasites in stomach or pylorus. In the spiral valve the following cestodes were found:

- Anthobothrium laciniatum*, few.  
*Discocephalum pilatum* (Eubozon of Marine Fishes of New England, n, pp. 781-787, pl. x, figs. 1-7) 12, large and small.  
*Orgymatobothrium angustum*, few.

The largest specimen of *Discocephalum* was over 40 cm. in length and 7 mm. in breadth. The last segments were almost square and nearly 4 mm. long. The disk-like head, resembling a mushroom anchor, was firmly embedded in the submucous coat in each case, and had to be dissected out before it could be removed.

One of the heads was stained in borax carmine and sectioned. Nerve cells were distinguished in the axis of the head in the basal part of the disk and also in the corrugated portion behind the head. Fibers from the axis continuous with those in the anterior part of the strobile diverge at the base of the disk and make up a large part of that organ. These fibers are most abundant and conspicuous in the basal part of the disk, as are also the vessels of the water-vascular system, which appear, indeed, in the anterior part of the disk, but are there few.

(3) July 27; one, young; remains of young mackerel in stomach. Two species of cestodes were found in the spiral valve.

- Anthobothrium laciniatum*, 19, both long and short necked varieties.  
*Phorciobothrium lasium*, 6, largest 32 mm.  
 (4) August 9; one; stomach contained partly digested fish of good size, probably a squeteague. Unfortunately only the stomach, including the pylorus of this specimen, was examined, the spiral valve having been taken by another for use as a specimen.

At the lower end of the stomach proper, not yet in the constricted pylorus, were four specimens representing three species, which, in view of the stomach contents, are of special interest.

- Echinobothrium* (?) larva, 1, active.  
*Tetrarhynchus bisulcatus*, 2, scolices only, active.  
 Nematode, immature, 1, partly digested.  
 The two cestodes are just such as are found in the squeteague, the former in the cystic duct and intestine; the other (*Tetrarhynchus*) encysted in the submucosa of the stomach. In the larva there was a faint indication of two red pigment spots back of the bothria. The nematode appeared to be identical with immature forms collected from a squeteague on August 5. The condition of these

specimens is interesting when it is remembered that when forms like these are taken from a squeteague and placed in ordinary sea water or normal salt solution the nematodes will continue active, often for days, while the cestodes usually cease activity after less than a day. When the cestodes were placed in Lang's aceto-picro-crotonic fluid bubbles of gas were given off, indicating the presence of gaseous bodies.

#### 4 *Sphyrna zygaena*, Hammer-head Shark.

(1) July 21, one, stomach contained remains of two menhaden. No entozoa in stomach or pylorus. From the spiral valve were obtained two nematodes, three scolices of *Otobothrium* (Entozoa of Marine Fishes, II, pp 840-853, pl VII, figs 9-15, XI, figs 1-4), and five specimens of *Phocobothrium laevis* (Cestoda Parasites of Fishes, p 447). The entozoa in this shark were in poor condition, as if partly incrimated.

(2) August 5, one, small, stomach with fragment of partly digested fish. No parasites of any kind found.

(3) August 18, one, stomach contained fragments of squids, spiral valve yielded a few specimens of *Phocobothrium laevis*. These specimens were exceedingly spiny, but the spines were easily detached, bothria had fluted posterior borders, and contracted to about one half their length when placed in picro-sulphuric acid, length, 12 to 23 mm.

Also from spiral valve one specimen of the genus *Platybothrium* (Entozoa of Marine Fishes, pp 820-823, pl VII, figs 8-10, IX, fig 1). See page 300 for description.

#### 5 *Carcharias littoralis*, Sand Shark.

(1) July 21, one, stomach empty. Large numbers of the cestode *Crossobothrium laevis* in spiral valve (Cestoda Parasites of Fishes, pp 445-446), large and small together, also several of the short variety noted in former papers, i. e., forms with mature segments beginning near the head. Whether these are to be looked on as a distinct variety or as individuals in which the proglottis forming energy is nearly spent I am not certain (Entozoa of Marine Fishes of New England, part II, pl VII, fig 4, p 800).

(2) July 23, one, stomach contents not noted, probably empty.

Numerous *C. laevis* in spiral valve.

(3) July 25, one, stomach with partly digested fish, probably flat-fish.

Numerous *C. laevis* in spiral valve.

Numerous *Echinorhynchus*, partly digested, in stomach, one in pylorus, evidently introduced with the food. *Echinorhynchus* oons often occurs in great numbers in the flat-fish (*Pseudopleuronectes americanus*).

(4) July 27, three stomachs contained fish (menhaden). The only parasites found were *C. laevis*, numerous in each. In one they were mainly adult, the longest measuring 42 cm. In one of the others a large number were young. These, contrary to their usual habit, were rather firmly fixed by their sucking disks to the intestine. One of the most variety found in this lot.

(5) July 28, one, stomach with fish (tautog). Forty-four specimens of a parasitic copepod (*Pandanus*) on fins. As usual, large numbers of *C. laevis* in spiral valve. A large proportion of these were young, and there were no free mature proglottides which are always very abundant in lots containing mature strobiles. The longest measured about 160 mm in length.

(6) July 29, one, stomach empty. *C. laevis* in considerable numbers in spiral valve.

(7) July 30, two, stomachs with partly digested fish. Fewer than ordinary parasites in spiral valve. One contained 10 *C. laevis* from 80 to 110 mm in length, the other contained the same number, all rather small, 5 to 25 mm in length.

(8) August 1, one, stomach with good-sized squeteague which had been bitten into two pieces. Spiral valve with numerous *C. laevis*, young and adult.

(9) August 8, one, stomach empty. *C. laevis* in spiral valve, numerous, young and adult.

(10) August 13, one, stomach empty. The shark had been confined in the pool for several days. *C. laevis*, young and adult, 12 in all, in spiral valve.

(11) August 18, one, stomach contained the claw of a small fish. *C. laevis*, young and mature, 37 in all, in spiral valve.

Very careful search was made in the spiral valve of a number of the foregoing specimens and sharks for other forms than the ever-recurring *C. laevis*, but without success.

6. *Squalus acanthias*, Spiny Dog-fish.

August 20; viscera of over 100 examined. These were collected at Rockport, Mass., by Prof. H. V. Neal, of Knox College, Galesburg, Ill. They had been placed in formalin, where they had lain about one week before they were brought to Woods Hole. The condition of the material was fairly good, so that if there had been entozoa in the alimentary canal at the time it was put into the formalin they should have been in good enough state of preservation for identification at least. The tissues of the stomach and spiral valve, the only parts saved, were in fair condition. No evidence of decomposition could be detected, and yet, after a careful search, no entozoa were found, except a small, immature nematode in the stomach of one, and the head and about 3 mm. of the body of a cestode, probably *Anthobothrium* from a spiral valve, with two or three cysts their tissues degenerated, in the stomach wall. Most of the spiral valves had been opened before preserving.

A few fish bones and scales and a small amphipod (*Gammarus*) were found in the stomach and intestine.

7. *Raja ocellata*, Big Skate.

(1) August 10; one; stomach empty. This specimen had been put in the pool in April. It had been dead probably a day before it was examined. It was in poor condition, evidently the result of confinement. Only mucus found in stomach and intestine. One cyst in stomach wall filled with a cheesy, degenerate mass. One nematode found in dish during the examination, probably from the intestine; an immature female, 21 mm. in length, living, though not very active; very transparent; length of oesophagus 3 mm.; cuticle thrown into fine transverse wrinkles; posterior end bluntly rounded with mucronate tip; length of tail 0.11 mm. Under the layer of longitudinal muscles the cells forming the intestinal tract could be seen. Upon focusing carefully, an open, somewhat reticulated, structure appeared in this cellular layer.

(2) August 11; another specimen taken at Menemsha Bight, Vineyard Sound, had no parasites.

(3) August 16; one; stomach with a large squid (*Loligo*) and one or two annelids; intestine with many annelids only partly digested.

One entozoon (*Rhynchobothrium imparipinne*) [Cestode Parasites of Fishes, p. 450] in intestine. The following measurements of the living specimen, in millimeters, are appended: Length 60; length of head and neck about 8, but very variable; average length of last six segments 1.5; length of last segment 3; breadth of last segment 1. Bothria on flat sides of strobile, varying from long elliptical and parallel to axis of body to oar-shape with cavities directed forward, then standing at about right angles to the axis of the body, or even with free borders directed forward in advance of apex of head; free border of bothria emarginate; color of worm yellowish white; first segments begin very close behind the contractile bulbs, at first broader than long, soon becoming squarish and ultimately longer than broad; reproductive cloaca in a deep lateral notch irregularly alternate and situated rather nearer the posterior end of the segment.

8. *Raja erinacea*, Common Skate.

(1) July 20; one; copepods and hermit crab in stomach. One nematode found in stomach.

(2) July 21; two; stomachs empty. One nematode in stomach of each. One *Echinobothrium variable* in spiral valve (Cestode Parasites of Fishes, p. 410).

(3) July 23; one; stomach empty. Two nematodes in stomach.

(4) July 26; one; stomach contained crabs (*Panopeus*) and annelids (*Nereis*). No entozoa except a few cysts, not determinable, in stomach wall.

(5) August 12; one; stomach and intestines with partly digested crabs (*Panopeus*); female, with one egg containing an embryo.

(6) August 16; two; stomachs with small shrimp (*Crangon vulgaris*). No entozoa.

9. *Tetronarce oocidentalis*, Torpedo.

(1) July 25; three; stomach and intestine contained nothing but mucus (exceptionally tenacious and of a brown color), one small fragment of a shell, and a part of a small fish vertebra. The digestion of the torpedo appears to be very powerful. The walls of both stomach and intestine are remarkably thick and heavy. The viscera, after removal from the body, were left lying in a pail for about 2½ hours. When they were then examined several holes had been digested through the intes-

in it will. One of the specimens had no cestodes, the other had in the spiral valve 1 large and 6 small specimens belonging to Monticelli's genus *Calyptobothrium*, which I refer to a new species, *C. occidentalis*. See p. 298 for description.

(2) July 26, one, contents of stomach and intestine as in lot (1), viz., brown, viscous mucus. In the intestine the only identifiable food substance was the crystalline lens of a fish. Two specimens of *C. occidentalis* in spiral valve. Three cysts in intestinal wall, each containing blastocyst and a larval *Rhynchobothrium* agreeing with form described in Notes on Cestode Parasites of Fishes, page 800, pl. LVII, figs. 9-11 (*R. imparipine*). The liberated larva remains attached to the blastocyst, which possesses an exhalant pore at the posterior end, and evidently functions as a nutrient vessel for the young worm. The torpedo was taken at the same time as those examined on July 23, but had been kept alive in a tank until the next day.

(3) August 22, one large female with one young, the stomach contained a partly digested flounder (*Paralichthys dentatus*) about 15 centimeters in length. No cestodes except what seemed to be loose segments, immature, of a small cestode in the spiral valve.

#### 10 *Dasyatis centrura*, Stingray

- (1) July 29, two, stomachs empty. The first specimen yielded the following cestodes:  
*Anthobothrium putatum*, 10 (Cestode Parasites of Fishes, pp. 439-440, pl. XXXIII, fig. 1)  
*Rhynchobothrium flexile*, 1 (Entozoa of Marine Fishes II, pp. 768-771, pl. V, figs. 3-5)  
*Rhynchobothrium cancellatum*, 3 (Entozoa of Marine Fishes II, pp. 771-773, pl. V, figs. 6-8)  
*Anthocephalum gracile*, 10 (Entozoa of Marine Fishes II, pp. 794-796, pl. VII, figs. 1, 2)  
*Phyllobothrium foliatum*, 16 (Cestode Parasites of Fishes, p. 443, pl. XXXIII, fig. 6)  
*Paratanais medusa*, 12 (Cestode Parasites of Fishes, p. 440)

*Rhynchobothrium hispidum*, numerous (Entozoa of Marine Fishes II, pp. 831-835, pl. VI, figs. 12-17)  
*Synbothrium filicollis*, from cysts, 1 (see Cest. Par. Fishes, pp. 815-830, pl. VIII, figs. 7-12)

A few cysts in spleen and stomach-wall for most part consisting of degenerate tissue. The second specimen, a very large one had been dead some five or six hours before the parasites were removed. They were not in first-class condition. The following entozoa were obtained:

- Rhynchobothrium flexile*, 1  
*Synbothrium variabile*, 7 (Cestode Parasites of Fishes, p. 412)  
*Isoanchocephalum peltatum*, 9 (Entozoa of Marine Fishes II, pp. 802-805, pl. IX, figs. 2-4)  
*Acanthobothrium paulum*, 30 (Entozoa of Marine Fishes II, pp. 816-819, pl. VIII, figs. 1-7)

With exception of the cysts the above named cestodes were found in the spiral valves of the rays.

(2) August 1, one, stomach with remnants of a crustacean (*Callinassa*). The following cestodes were obtained from the spiral valve: *Anthobothrium putatum*, 2, and numerous free proglottides, *Synbothrium variabile*, 1, *Anthocephalum gracile*, 3, longest measuring 46 mm. *Phyllobothrium foliatum*, 9, *Rhynchobothrium hispidum*, numerous.

Three proglottides from several of these cestodes were observed to keep up active progressive movements in seawater for four hours after they were collected, that is until they were killed. The resemblance in such cases, to a trematode is very striking.

(3) August 17, one, small, stomach empty. No parasites, except a few cestode cysts in spleen and stomach-wall. Some of these contained blastocysts, but the larva were too young to be identified, probably *Rhynchobothrium*.

(4) August 18 one. This ray was placed in the pool and was not killed during my stay at Woods Hole. Six external trematode parasites collected, *Epidella bumpusi* sp. nov. See page 286.

(5) August 22, one, small, stomach empty. One *Anthobothrium putatum* in spiral valve. One cyst in spleen from which a blastocyst was obtained not far enough developed for identification. Other cysts in wall of stomach and pylorus had degenerated to yellow masses of cheesy consistency.

(6) August 23, one, stomach empty. In spiral valve were found *Anthobothrium putatum*, 2, *Phyllobothrium foliatum*, 1, *Paratanais medusa*, *Rhynchobothrium* sp.

#### 11 *Myliobatis fremmilleri*, Sharp nosed Ray

July 27, one, stomach contained pieces of fleshy part of some large univalve mollusk, probably *Scyotypus*. From the spiral valve were obtained:

- Rhynchobothrium longicollis* (Cestode Parasites of Fishes, p. 441, pl. XXXIII, figs. 2-4) very numerous  
*Rhynchobothrium gracile* (Cestode Parasites of Fishes, p. 451, pl. XXXIV, figs. 12-13) 30,

From the pylorus was obtained a single specimen of *Tetrarhynchus robustus* (Cestode Parasites of Fishes, p. 452).

One of the larger specimens of *R. agilis* measured 95 mm. in length. It was noticed that these specimens contracted very greatly when placed in the killing fluid (Long's aceto-picro-mercuric fluid), especially the mature and maturing proglottides, some of the latter contracting to one-fourth their length. Specimens were then stretched on the bottom of a glass dish and allowed to lie there a short time until they were fastened by their own mucus. They did not then contract when the killing fluid was placed on them.

#### 11a. *Catostomus commersoni*, Common Sucker.

August 26, I received a specimen of sucker and a bottle containing a large number of parasitic copepods, which were sent to me by Dr. H. M. Smith. Along with the specimens was a letter from J. W. Titcomb, superintendent of the Fish Commission station at St. Johnsbury, Vt. The fish and parasites had been collected by J. W. Parks, Montpelier, Vt. Mr. Titcomb wrote:

Through the courtesy of J. W. Parks, veterinary surgeon at Montpelier, Vt., I have obtained a lot of specimens of the parasite which infested the river there this summer and a sucker which had been attacked by them. It will be noticed that one of the pectoral fins is quite badly eaten and a spot on the fish below it. These parasites usually attack the pectoral fins first. They are sometimes found on the eyes of the fish and apparently stand on their heads in working into the fish.

These parasites belong to the genus *Argulus*, probably *A. catostomi* Dana and Herrick. The abraded place on the side of the fish was examined and the tissues were found to be penetrated by the hyaline of some fungus, presumably a species of *Saprolegnia*. Since the mouth parts of *Argulus* are fitted for piercing and sucking, and not for biting, it seems rather hard to account for the frayed and tattered condition of one of the pectoral fins of this fish. Because of the presence of the fungus noted above, I stated in my letter to Dr. Smith relative to this case that these parasites may not have been wholly to blame for the damage, although the trouble might have been started by them.

Later I received a letter from Mr. Parks, dated September 20, in which he gives an interesting account of his observations on the effect of these parasites on trout and suckers. The following extracts give the substance of his observations. After speaking of a fish which had no marks of any kind upon it when he first saw it, which was swimming in shallow and clear water, he proceeds:

First the fish swam along in the usual manner feeding, but soon became uneasy, this increasing until it seemed to become frenzied. This stage does not last more than 30 minutes, however—and then it commenced to turn upon its back and became comatose and soon died. To make sure the parasite was the cause of death I obtained trout and suckers from an adjacent stream, and after placing the sucker in a tank of fresh water I dropped in about fifty of the parasites, which at once attacked the fish. While they were upon the sucker I placed three trout in also. In 55 minutes I noticed signs of frenzy and in 75 minutes coma, and in 90 minutes the first trout was dead, and upon examination I found the left pectoral fin completely stripped, the right eye destroyed, a spot near the tail stripped of the scales the size of a ten-cent piece. I find that suckers can live longer than trout, also the parasites will go from a sucker to trout.

The *Argulidae*, according to Claus (*Zeitschrift für Wissenschaft, Zool.*, xxv, 3, 1875, p. 277), live on very different sorts of fish, and chiefly on the plasma of the blood to which they obtain access by means of modified mandibles and maxillæ which are transformed into a piercing and sucking organ.

#### 12. *Anguilla chrysops*, Common Eel.

(1) July 25; one; stomach empty.

Cestodes: Cysts containing larvae, no mesenteries, several, *Rhynchobothrium inaparinum* Lk. (Contrace Parasites of Fishes, p. 450.)

Nematodes: one encapsuled on liver, immature; not yet identified. There was an inflamed patch on the stomach wall and on the intestine, evidently caused by a wound on the side.

(2) August 5; one; partly digested fish in stomach.

One hyaline cyst on viscera, containing a *Rhynchobothrium* larva. When released it remained attached to the blastocyst.

(3) August 29; one; stomach empty.

The only entozoon found was a single immature cestode larva of the type which I have found in the alimentary canals of a variety of fish; small, with two red spots on the neck. (Larval Cestode Parasites of Fishes, pp. 789-792, pl. LXI, figs. 4-15.) The stomach and intestine were washed and the contents looked over very carefully with the above meager result. The specimen had been in an aquarium for a few days.



13 *Clupea harengus*, *Herring*

September 5, one, young, stomach with enormous numbers of copepods of several species, young shrimps in large numbers and numerous crabs in the megalops stage. The fish was taken with a dip net at the surface where it was feeding. A few small cysts containing blastocysts were found on the viscera. The blastocysts contained larval *Rhyssobolothrix*, the hooks of which agree with those figured in my report on larval cestodes (pl. xvi, fig. 5). The longest hooks measured about 0.017 mm. One of the cysts averaged measured 2 mm in length and 1.4 mm in the shorter diameter. One encapsulated nematode was found immature.

14 *Bievoortia tyrannus*, *Murchison*

(1) July 21, five, stomachs empty.

Elongated cysts and blastocysts on viscera (*Syngnathium*) (?) (Larval Cestode Parasites of Fishes, pp. 815-820, pl. LXXIII, figs. 7-12.)

(2) August 15, two, stomachs empty save sand and fine material not identifiable with lens.

Cestodes. Three elongated cysts on viscera and a considerable number of larval cestodes of same gonial type as those found in cystic duct of squeteigne, although the head seemed to be proportionally larger, red pigment back of head observed in some. (Larval Cestode Parasites of Fishes, pp. 789-792, pl. LXI, figs. 4-15.)

Nematodes. Three small specimens, very slender, and about 8 mm in length.

15 *Cyprinodon variegatus*, *Short Finnem*

July 23, two, each with several tumors caused by psorosperms (*Myxobolus lentoni* Curley).

August 23, another specimen, which had been kept for a month in an aquarium, also with tumors. On the surface of the tumors a number of small white specks were noticed. This was after the specimen had been lying overnight in 2 per cent formalin; these specks were on the surface and looked like masses of coagulated mucus. When transferred to a slide and examined under a considerable magnification they were found to be definitely limited clusters of psorosperms. When flattened under the cover glass they became elliptical in outline.

Dimensions in millimeters. Length of elliptical mass, 0.25; breadth, 0.2; length of single psorosperm, 0.011; breadth, 0.010; length of oval bodies, 0.004.

No special search was made for this parasite. Dr. Gorham reported that other specimens similarly affected were seen earlier in the summer. Several specimens were taken during the summer with these tumors, but no formal record was kept of them.

16 *Tylosurus marinus*, *Gad-fish*

August 27, three, small, stomachs of two empty, other with small fish (silver-sided). Larval cestodes with two red pigment spots in neck in intestine. (Larval Cest. Parasites of Fishes, pp. 789-792.)

*Gasterostomum* sp. one, in intestine, see page 298 (fig. 81) for description.

17 *Sarda sarda*, *Bonito*

(1) July 20, three, stomachs empty.

*Tyranhynchus bicolor* (Larval Cestode Parasites of Fishes, pp. 813-815, pl. LXXIII, figs. 1-6), from cysts under peritoneum.

*Gasterostomum arcuatum* sp. nov. See page 297 for description, very numerous in pyloric caeca and intestine.

One small nematode, immature, encapsuled on serous coat of intestine.

(2) July 23, one, a small shell in stomach. External copepod parasites in mouth.

One larva in blastocyst, enveloped in a delicate cyst, colorless or white with yellow blotches at the ends. This was found in the muscular tissue near the anus. After removal from the cyst it was active and crawled with progressive motion on the bottom of a watch glass. It appears to be *T. bicolor*.

(3) July 28, two, stomachs empty. No parasites found except copepods, two on one and one on the other, in mouth.



- (4) August 1; one; stomach with nearly digested remains of small fish; no parasites.
- (5) August 6; eight; stomachs empty except in one case, where nearly digested small fish were found, also jaws of small squid and small arthropods, apparently copepods and amphipods. One slender blastocyst liberated from cyst on pyloric caeca, very active. See page 300 for additional details.
- (6) August 8; fourteen; the stomachs of most of them with fragments of nearly digested fish. A few copepod parasites from the mouth of one, other heads not examined. One cyst from viscera, not determined.
- Trasterosomum arcuatum*, few, from pyloric caeca at juncture with intestine. See (1) ante.
- (7) August 10; seven; August 11, one; stomachs of several contained partly digested small fish. One larva (*Tetrarhynchus*), also a few cysts, not determined, from stomach wall. Two of these had become degenerated. Two elongated cysts on pyloric caeca.
- (8) August 15; two; stomach contents not noted, probably empty. No parasites found.

#### 18. *Scomberomorus regalis*, Spanish Mackerel.

August 10; one; stomach nearly empty, the vertebra of a small fish being all that was distinguished. Numerous cysts containing blastocysts and larvae (*Synbothrium*) under serous membrane on pyloric caeca and ovaries. (Larval Cestode Parasites of Fishes, p. 815-820, pl. LXVIII, fig. 7-12.) The posterior end of one of the blastocysts was bifurcate.

#### 19. *Xiphias gladius*, Sword-fish.

July 17; two; stomachs with hake, young cod, and beak of a squid. These fish had a number of trematode parasites on the gills (*Tristramia*), most of which, however, had been removed before I saw the fish. The following were obtained by me:

*Acanthocephalus*, from stomach, 24, large and small together.

*Rhynchobothrium attenuatum* (Larval Cestode Parasites of Fishes, pp. 805-806, pl. LXV, figs. 8-11). Three found on serous membrane in vicinity of reproductive organs of one of the fish. One of these larvae, while lying in fresh water, extended itself until it was 180 mm. or more in length.

*Dibothrium pilosum* (Cestode Parasites of Fishes, pp. 430-431). Two specimens from one host and one from the other. These specimens were all in the rectum of their several hosts and firmly attached. In two cases the heads penetrated simply the mucosa and submucosa coats. The other specimen had penetrated the intestinal wall and was surrounded by a globular cyst about 12 mm. in diameter which protruded into the body cavity.

*Tristramia coccineum*, from gills; 4 specimens. (Trans. Far. Fishes, pp. 508-510, pl. XL, fig. 9.)

#### 20. *Naucratus ductor*, Pilot-fish.

August 23; one; stomach empty. No entozoa.

#### 21. *Pomatomus saltatrix*, Blue-fish.

(1) July 20; one; stomach with young herring. Numerous small cestode cysts (*Tetrarhynchus*) in stomach wall. Elongated cysts (*Synbothrium*) on mesentery and serosa covering of viscera.

(2) July 21; two; stomach of one empty, the other with fragment of squid (*Loligo*). Numerous cysts in stomach wall (*Tetrarhynchus*); several elongated blastocysts with thin or imperfect cysts on viscera (*Synbothrium*).

(3) July 23; one; stomach contained a small eunner (*Trutogolabrus*). The nasal large numbers of cysts (*Tetrarhynchus*) in submucosa of stomach. See page 301 for additional notes.

(4) July 26; one; stomach contained pieces of squid (*Loligo*). Numerous cestode cysts on viscera and in liver.

(5) July 30; one; stomach empty. Large cysts containing blastocysts, which were active when liberated, three on mesentery and one in stomach-wall between mucosa and submucosa. The larvae proved to be examples of the species *Rhynchobothrium speciosum*. (Larval Cestode Parasites of Fishes, pp. 801-805, pl. LXIV, figs. 13-14; LXV, figs. 1-7.)

(6) August 8; two; stomachs contained partly digested fish. No entozoa found except a small, immature nematode in the stomach.

22 *Palunenchthys peleciformis*, Hudder fish

(1) August 10, one small, stomach contents not noted. An enormous number of small distomata on and in the pyloric caeca, *Distomum pyriforme*. See page 293 for description.

(2) August 19, six, stomach contents not noted. Larval cestodes in general similar to forms found in aquaria, flounder, goose-fish, etc., in intestine, but very small. Dimensions of living specimens, in millimeters: Length 0.14, breadth 0.17; specimen with head invaginated, length 0.26, breadth 0.14. A few small distomata, *D. pyriforme*, in intestine.

*Echinochynchus pristi*, var. *leuconcaris* (Petersen of Marine Fishes, III, pp. 531-532, pls. 15, figs. 39-41, v, figs. 12-53), from intestine, one.

One small immature nematode also found, from intestine.

(3) August 22, three, stomachs contained small univalve shells (*Littorina tenuitata*), and the slender crustacean, quite common among hydroids (*Caprella geometrica*). Larval cestodes, and numerous small distomata, as in lot examined August 10. These cestodes were from the alimentary canal in the vicinity of the pyloric caeca.

(4) August 23, four, stomachs contained young squid (*Loligo pealii*), crustacea. Larval cestodes and small distomata as in preceding lots, obtained by opening the alimentary canal, and washing contents in a dish of sea water. One of the former appeared to have a more prominent myzothelium than usual.

23 *Rhombus triacanthus*, Butter-fish

(1) July 21, one, stomach contents not noted, probably empty. Numerous immature nematodes on viscera.

(2) July 23 one, stomach contents not noted. One small cyst containing blastocyst and larva (*Lithochobotrium*), and enormous numbers of immature nematodes on and among the pyloric caeca. The combined bulk of the worms appeared to be almost equal to that of the pyloric caeca.

(3) August 10, three, stomach contents not noted. Serous coat of pyloric caeca with large numbers of immature nematodes.

(4) August 22, four, stomach contents not noted. A few small cysts and numerous small, immature nematodes found on pyloric caeca.

24 *Morone americana*, White Perch

August 27, three, small, stomach full of shrimps.

*Distomum areolatum* Rudolphi. See page 293 for description, rather numerous, found in dish in which viscera had been lying.

Numerous pigment patches on viscera generally, especially on liver, but also abundant on mesentery, stomach, and intestine. A study of the tissue affected with these patches confirmed certain conclusions recorded in my Notes on Trematode Parasites of Fishes, page 537.

Large numbers of cysts in various stages of degeneration were found. In most of them ova, which are without doubt the ova of some distomum, formed the nucleus of the cyst. These ova measured about 0.020 and 0.013 mm. in the two principal diameters. They therefore do not belong to *D. areolatum*. The principal steps in the degeneration of the cysts to pigment were represented by (a) one or more ova with cyst of connective tissue just beginning to form, (b) others with cyst of connective tissue fully formed, (c) others with cyst and the contained ovum or ova surrounded with a waxy secretion, (d) a waxy mass with no ova visible, also masses of dark-brown, almost black pigment. Sections of the liver were made but no pathological conditions were noted further than the presence of pigment patches in the serous coat, some of which contained large numbers of ova, 6,100 estimated in one patch through which sections were made, and about half of them mounted serially.

25 *Centropristis striatus*, Black Sea-bass

(1) July 28, one, stomach empty. The fish had been in an aquarium for several weeks. The only parasites found were numerous small cysts containing larval cestodes in the submucosa of the stomach. See page 301 for supplementary note.

(2) August 3, one, stomach with a few small fish newly digested. The fish was taken from an aquarium where it had been kept for several weeks. A few cysts on the mesentery and under the serous coat of the liver. One of the cysts when opened released a blastocyst to which the larval

Rhynchobothrium remained attached when it was forced out by pressure. A few encapsulated nematodes among the cysts on the mesentery, the intestines of which were somewhat folded or crumpled, white by reflected and pale reddish or yellowish brown by transmitted light.

#### 26. *Stenotomus chrysops*, Scup.

(1) July 19; sixteen, about two years old; stomachs empty. Several nematodes and a few cysts on serous covering of viscera. Small cestode larva, similar to those found in squeteague, flounder, etc., in intestine.

(2) June 14; small nematodes and cysts from body cavity, collected by Dr. F. P. Gorham, agree with lot (1).

(3) July 25; two; stomachs contained annelids and amphipods. Cestode cyst and nematodes on viscera—same as lot (1).

Leech, slender, yellowish-brown, with three longitudinal rows of white blotches, one on each side and one dorsal, about eighteen in each row; suckers bluish-white. Although this leech was found on the scup, it probably came from one of two flounders which were in the same pall with the scup. In the same pall were, in addition to these, an eel, a blue-fish, and two sea-robbins.

(4) July 30; one; stomach with young squid. A few nematodes on viscera, same as in lot (1).

(5) August 1; one; small globular cysts in kidneys, collected by Mr. E. E. Tyzer. See page 301 for description.

(6) August 5; two; stomachs empty. Small immature nematode on mesentery. Dimensions, in millimeters: Length (alcoholic), 8. Other dimensions from life. The worm was transparent, and the brownish intestine had an anteriorly projecting diverticulum 0.14 in length; length of esophagus, 1.42; head with prominent papilla on ventral lip and two others less distinct; posterior end slender acuminate; distance from anal aperture to posterior end, 0.14.

(7) August 16; two; stomachs contained hydroids (*Pennaria*). Two small nematodes and one small distomum from viscera. The body of the distomum was covered with minute scale-like spines. For further details see page 296 (fig. 72).

(8) August 22; thirty-one; stomach contents not noted. Careful search was made in the hope of getting more examples of the distomum found in (7). Only a few small, immature nematodes and encysted larval Rhynchobothria found. The latter agree with the form described in my Notes on Larval Cestodes of Fishes, pp. 796-797, plate LXIII, figs. 9-13.

#### 27. *Cynoscion regalis*, Squeteague.

(1) July 18; two; stomachs empty.

Cestodes: Larval Rhynchobothria in cysts on viscera. Larval cestodes in gall bladder, very numerous in one, attached in clusters to mucous lining of gall bladder; in the other few. (Larval Cestode Parasites of Fishes, pp. 780-792, pl. LXI, figs. 4-15.)

Nematodes: Numerous in cysts on viscera. These were small, immature, for the most part of a brown color, especially those recently liberated from cysts.

(2) July 19; five; stomachs contained young herring and butter-fish.

Cestodes: Numerous cysts containing larval Rhynchobothria and Tetrarhynchini on serous covering of viscera. The usual larval cestodes in gall bladder and cystic duct, the clusters forming swellings in the cystic ducts of some, which look as if they might occlude the duct in some cases.

Nematodes: Numerous immature nematodes encysted on serous membrane of viscera.

Acuothorophali: *Echinorhynchus proteus*. Two of the fish with several specimens in intestine. In each case the head and globular bulla had penetrated the intestinal wall and were protruding into the body cavity. (Entozoa of Marine Fishes, part III, pp. 537-538, pl. VIII, figs. 85-88.)

(3) July 23; three; stomachs not noted. Cestode cysts on viscera, especially on mesentery. Large numbers of immature nematodes, free and encapsuled on mesentery.

(4) July 28; three; stomachs with half-digested fish. Numerous cysts (*Tetrarhynchus*) in stomach wall; cystic ducts of two with the usual cestode larva.

(5) July 29; eighteen; stomachs with partly digested fish. The usual entozoa in each, viz: *Tetrarhynchus* larva encysted in the stomach wall. Cestode larva in cystic duct. Nematode and cestode cysts in mesentery.

(6) August 5; two; stomachs empty. Cystic ducts with the usual larval cestodes, free in the lumen of the duct and in gall bladder, and loosely attached by their heads to the mucous membrane. Masses of cestode cysts and encapsuled nematodes on mesentery.

(7) August 15, eight, stomach contents not noted. Cystic ducts with usual larva. *Tetrarhynchus* larva in stomach walls, not abundant. Numerous small immature nematodes on mesenteria. About 20 specimens of *Echinorhynchus proteus* in a cluster in one of the sigmoides, within about 25 mm of the anal end of the intestine. The heads of these worms had penetrated the intestine and the serous side of the intestine at this place was covered with cysts, some of the latter were opened and revealed wax concretions similar to those described in a former paper, though in these cases all were small. (Entozoa of Marine Fishes, 1880, p. 197, pl. xi, fig. 5, a and b.)

(8) August 16, one, stomach contents not noted, probably empty. Larva in cystic duct and gall bladder, as usual.

(9) August 25, ten, stomachs with fish and squids. The usual larval cestodes in cystic duct and gall bladder also in the intestine others similar but smaller, and all with two or three bladders in the neck. Larval *Tetrarhynchus* cysted in stomach wall, small cysts and nematodes on mesentery. One much elongated blastocyst on mesentery of one of the fish. Length of anterior portion in life varying from 7 to 11 mm, length of the posterior slender portion, 70 mm or more. When placed in the killing fluid the anterior part, which in life was oblong and translucent, contracted to a globular shape, 5 mm in length and became tense, opaque, and of a dead white color, the posterior portion, when straightened in the killing fluid, measured 90 mm in length, and was transparent and colorless. The larva, when liberated from the anterior portion, was found to have well-developed hooks on the proboscides and proved to be a species of the genus *Tetrarhynchus erinaceus* Beneden. (Larval Cestode Parasites of Fishes pp. 811-812 pl. LXXII, figs. 1-8.)

### 28 *Tautogolabrus adspersus*, Cuvier

(1) August 10, six, small 9 to 10 cm in length. Scales of fish found in stomachs of three, others empty, one cyst containing blastocyst and larval *Rhynchobothrium*. The proboscides were retracted and the specimen was too immature for satisfactory determination. The arrangement of hooks suggested *R. heligae*. (Cestode Parasites of Fishes, p. 118, Larval Cestode Parasites of Fishes, p. 793.)

(2) August 16, one, a good sized specimen, in stomach were bits of sea weed and a tunicate (*Cynthia parvula*). Five or six amber colored cysts on and in the testes and one of similar nature on liver. These had the general appearance of a cestode cyst but contained only wax, degenerate connective tissue. Two of the larger cysts were surrounded with patches of fat cells.

(3) August 26, ten, small, stomach contents not noted. Several small cysts, containing blastocysts and larvae, on viscera. These appear to be the same as form mentioned in my notes on Cestode Parasites of Fishes page 794, pl. LXXII fig. 2.

(4) September 5, five, stomach contents not noted. No entozoa found except in one. Skin with immense numbers of cysts and pigment patches producing a blue-black color effect which makes the infected fish a very conspicuous object, due to immature distoma. For further details see page 296 (figs. 70-81).

### 29 *Spheroides maculatus*, D'Aguiar

(1) June 13 and 14, one on each date, stomach contents not noted. Specimens collected by Dr. F. P. Gorham.

Numerous distoma from intestine and pharynx, large and small of same species. The largest were from the pharynx attached to the walls around entrance to the pouch. I refer this distomum to a new species, *D. riber*. See page 291 for description and general account.

One cestode cyst (*Echinorhynchus* sp.), a larva and one specimen of *Echinorhynchus*, probably *E. acis*, in bottle with the distoma. Mr. Gorham obtained all of these from the pharynx of the fish. The *Echinorhynchus* is a female, length, 10 mm. The hooks and general proportions, proboscis and body, agree with *E. acis*. The specimen is much smaller, however, than is usual in that species. The kinestics were indistinctly seen.

(2) July 20, one, small, less than 20 mm in length. Small distoma probably young of *D. riber*, in intestine. Collected by Dr. F. P. Gorham.

### 30 *Mola mola*, Sun fish

July 18, one alimentary canal filled with digested material of the consistency of thick soup. Visual N. Edwards tells me he has usually found them "full of jelly-fish." The fish had been taken off No. Man's Island by a party from the Marine Biological Laboratory. The external parasites, of which I was told there were many, probably *Limnodynastes indophanum*, had been removed by the capturing party and were not seen by me.

The following entozoa were found:

*Dibothrium microcephalum* (Ent. Marine Fishes, II, pp. 739-745, pl. II, figs. 5-18), young and adult in intestine. The largest specimen measured 50 cm. in length and 7 mm. in greatest breadth.

*Tetrarhynchus elongatus* (Larval Cestode Parasites of Fishes, pp. 812-813, pl. LXVII, figs. 9-12) and possibly another species; enormously long blastocysts burrowing in the substance of the liver. The enlarged and in some cases globular portion as a rule lay immediately under the serous coat, while the slender, liliform posterior part penetrated the deeper tissue.

*Distomum macrocylle* (Trematode Parasites of Fishes, pp. 522-523, pls. XLV, figs. 8-11; XLVI, figs. 1-5), 1 intestine.

*D. foliatum* (Trem. Par. Fishes, pp. 532-531, pls. XLIX, figs. 3-5; I, figs. 1-3; II, figs. 1-1), 3, intestines.

*D. nigrofurum* (Trem. Par. Fishes, pp. 530-531, pls. XLVIII, figs. 8-11; XLIX, figs. 1, 2), 1, intestine.

*D. fragile*, rather numerous. See page 295 for description.

### 31. *Myoxocephalus senes*, *Sculpin*.

July 23; one; nothing identified in stomach. One small nematode in the body cavity.

### 32. *Prionotus carolinus*, *Guard or Sea Robin*.

(1) June 5; scolices of *Tetrarhynchus bicaudatus* found by Dr. F. P. Gorham encysted in stomach and intestinal walls; also the same cestode in muscles, but not encysted there.

(2) July 21; one; stomach empty. One larval *Rhynchobothrium* and one larval *Tetrarhynchus* found in the body cavity.

(3) July 25; two; stomach empty. Nematode, immature, on viscera; no other entozoa found.

(4) August 5; three; fish scales in stomach of one, others empty. A few small nematodes found on mesentery. These were immature, rather thick-walled; inner outline of body wall irregular; posterior tip minutely uncinuate; intestine brownish; anterior end truncate.

(5) August 21; two; small; stomachs empty. Three distomum from intestine. See page 295 for description (fig. 71).

### 33. *Lopholatilus chamaeleonticeps*, *Tile-fish*.

September 1; five; stomachs more or less everted and empty; intestines with considerable quantities of partly digested crabs. The fish were taken in 135 meters (75 fathoms) of water south of Newport. The viscera of these fish had been put in formalin and were examined by me September 3. The contents of stomachs and intestines were examined with great care for entozoa. There were found about a half dozen fragments of immature nematodes, evidently taken in with the food; one of them was coiled up, as if it had been encapsuled; one cestode in two pieces, small, could not be identified, but looks like *Tenia*.

One distomum was found which seems to be new. See page 288, *Distomum fauconum* sp. nov.

### 34. *Opsanus tau*, *Toad-fish*.

September 5; two; fragments of fish in stomach. Nematodes in stomach and intestine of each, *Ascaris habrua* sp. nov. Eight specimens from both. See page 292 for description.

### 35. *Merluccius bilinearis*, *Hake*.

(1) June 4; a vial with specimens collected from a hake by Dr. F. P. Gorham contained parts of pyloric caeca and pieces of gills. On the latter were small cysts not identifiable, apparently very young encysted distomum. One small distomum in the vial. A few immature nematodes obtained from the pyloric caeca. I refer the distomum to *D. ocratum* Molin. provisionally. See below.

(2) July 30; one, young; stomach empty. Fish had died in an aquarium. No parasites found.

(3) August 29; one; stomach contained fragments of fish. Larval cestodes in intestine; numerous cysts (*Rhynchobothrium*) on mesentery and in walls of stomach; small distomum of two kinds found in dish into which contents of intestine had been washed.

*Distomum* (*Apobtema*) *ocratum* Molin. See page 296 for further details.

*Distomum rufelloum* sp. nov. See page 290 for description.



36 *Pollachius virens*, Vollock

July 14, one, collected by H. M. Kelly

*Ascaris clausa*, about 50, stomach. See page 302 for additional notes

*Distomum ocellatum* Molin, about 100 stomach. See page 288 for additional notes

*Otobothrium denticulatum* Olsson, one, gills. See page 283 for additional notes

*Rhynchobothrium*, encysted, mesentery

37 *Paralichthys dentatus*, Summer Flounder

(1) July 19, five, stomachs contained only young squid (*Loligo pealii*). Larval cestodes in cystic duct of one, as in aquileague also many scattered through the chyle of the intestine. Many cestodes (*Tetrahychus*) encysted in walls of stomach and intestine of each. A few nematodes, immature, encysted in mesentery of each.

(2) July 20, one, large, stomach empty, numerous external copepod parasites on skin, one leucian parasite affixed to pectoral, an encysted larva (*Tetrahychus*) with margins of bothria bristly, in submucosa of pyloric end of stomach (*A. robustus*) (Cestode Parasites of Fishes, p. 452). A few encysted nematodes, immature, and an encysted *Echinorhynchus* on mesentery. In the latter the body was orange colored, the head and neck translucent, colorless.

(3) July 22, one, contents of stomach not noted, probably empty, larva (*Tetrahychus*) in stomach and intestinal wall, and small immature nematodes in mesentery. See also page 285.

(4) July 23, two, stomach contents not noted, probably empty, one leucian parasite in mouth, cystode cysts in stomach and intestine, as in foregoing contents of intestine washed out and examined with care, numerous larval cestodes, very small and very active after lying in water for eight hours, same as in foregoing.

(5) July 25, two, stomach contents not noted, probably empty, nematodes on viscera, *Tetrahychus* larva encysted in stomach wall, rather numerous in vicinity of pylorus.

(6) July 27, one, stomach contents not noted, large number of larval cestodes from cystic duct, small nematode from viscera.

(7) July 28, one, stomach contained young squid (*Loligo*), external copepod parasite on skin on upper side, cystic duct with large numbers of larval cestodes rather numerous cysts (*Tetrahychus*) in submucous coat of stomach.

(8) July 30, two, stomach contents not noted, probably empty, the usual cysts in stomach wall, also numerous cysts under serous coat of stomach. As the latter appeared to be new in this host, the following measurements were taken, in millimeters: Length of cyst, 1.12, shorter diameter, 0.73, length of blastocyst, 0.81, length of larva 0.52, length of bothrium, 0.18, breadth, 0.18, length of bulbs, 0.35, length of longest hooks 0.021 to 0.034, bothria slightly emarginate. The hooks all of various shapes and agree with *Rhynchobothrium heterospine*.

(9) August 8, one, stomach contents not noted, probably empty. Nematodes and one *Echinorhynchus* encysted in mesentery. The latter had its proboscis partly retracted. When it was placed in the killing fluid the proboscis was gently pulled, when a slender neck made its appearance and the specimen was identified as a young *L. proteus*.

(10) August 16, one, stomach contents not noted, probably empty, the usual cysts in stomach wall, numerous small white cysts under serous coat of stomach, which appear to be same as those recorded under date of July 30 (*Rhynchobothrium heterospine*).

(11) August 25, two, stomachs with young eel (*Stenotomus chrysops*) and young squid (*Loligo pealii*). The commonly occurring cysts were found in the stomach wall. The alimentary canals of these flounders were washed out and search made for small distoma, only one specimen was found, *D. pudens* sp. nov. See under date of September 5 below, also page 290 for description.

(12) August 27, one, stomach contents not noted, probably empty, parasite copepods on side, one nematode (*Ichikowia sanguinum*) partly embedded on inside of cheek. See page 301 for the description. A few small distoma (*Distomum dentatum*) were obtained from the intestine, see page 294 for description, also two small distoma, belonging to the subgenus *Ipobrama*, which I refer to the species *I. appendiculatum*, see page 289 for description.

(13) September 5, four, stomach contents not noted, probably empty, external copepod parasites on side, a leucian from mouth of one, two immature encysted nematodes and several young encysted *Ichthyophthirius*, orange yellow, from viscera, identified as *L. proteus*. Numerous distoma (*D. pudens* sp. nov.) See under date of August 25 and page 290 for description. The usual cysts were present in the stomach walls of these flounders, indeed they appear to be rarely, if ever, absent.



38. *Limanda ferruginea*, Sand Dab.

June 29; one specimen of *Dibothrium punctatum* (Cestode Parasites of Fishes, pp. 430-431); collected by Mr. S. R. Williams from the intestine of the flounder on the above date.

39. *Pseudopleuronectes americanus*, Winter Flounder.

(1) July 25; two, small; stomachs empty; one with six *Echinorhynchus acus* (Entozoa of Marine Fishes, III, pp. 525-528, pls. 1, figs. 1-11; VIII, figs. 89-90) in intestine. These were colorless and yellowish white, with the exception of the burse of the males, which were bright orange.

(2) Specimens of *E. acus* from intestine; collected by Mr. S. R. Williams June 11 and July 2.

(3) July 25; one; collected by Dr. Ulric Dahlgren; five specimens of *E. acus* from intestine.

(4) September 5; one, small; stomach empty; no entozoa found.

40. *Lophius piscatorius*, (Loose-fish).

(1) August 11; one; stomach empty.

Numerous cestode cysts in the mesentery. One of these was opened and the blastocyst yielded a specimen of *Rhynchobothrium spicatum* (Larval Cestode Parasites of Fishes, pp. 801-805, pl. LXIV, figs. 13-14; pl. LXV, figs. 1-7); other species also represented not yet identified. The intestine contained immense numbers of the larval cestodes, small, and like those observed in this host in previous years, with two red pigment patches in the neck. They possess considerable vitality and were active after being in normal salt solution for twenty-four hours. While living, these specimens attached themselves firmly to the bottom of the dish with their suckers, the body floating in the water. Even strong suction with a pipette often failed to dislodge them at first. (Larval Cestode Parasites of Fishes, pp. 780-782, pl. LXI, figs. 4-15.) Several nematodes encased in the mesentery and a considerable number, apparently the same species, free in the intestine. These were small and immature.

(2) August 20; one; stomach empty. A number of cestode cysts found in the walls of stomach and intestine, for the most part under the serous coat, but also found involving the deeper layers, some of them even showing more plainly on the inner than on the outer side of the intestinal wall.

Enormous numbers of the small larval form with two red pigment spots in the neck, noted above. No attempt was made to estimate the number. There were certainly many thousands of them within a small area and they occurred for the greater part of the length of the intestine.

Three Acanthocephali, apparently *Echinorhynchus acus* (Entozoa of Mar. Fishes, III, pp. 525-528, pl. 1, figs. 1-11, pl. VIII, figs. 89-90), 22, 30, and 31 mm. in length, respectively, all females, found in intestine.

(3) May 28. A few nematodes obtained from the liver of a goose-fish by Mr. Lawrence E. Griffen on above date, similar to those mentioned above—in part at least, probably identical with *Agamonea rapanaria* Diezing.

In previous years I have found *Ascaris increasens*, *Ascaris* sp. (immature), and others probably belonging to the genus *Ascaris*, but too young for satisfactory determination.

## PART II

## Parasitic Copepod from the Squeteague

[Plate 31, figs 1-5. U. S. N. M. No. 6407.]

I include in this report notice of a copepod parasite found by Mr. T. L. Tuxter, July 22, under the skin on the propopercular bone of a squeteague (*Cynoscion regalis*). One specimen was given to me on the date of capture and a sketch was made of it while it was still alive. There was a mass of over a hundred associated with the specimen and a few were attached to the forked tail. Later two other smaller specimens were given to me, which had been found in the same fish in the same position, but on the opposite side of the head. The larger, when viewed from above, had the following characteristics.

Head bluntly rounded in front, obscurely cordate behind. A single median, orange-colored pigment spot suggesting in position the eye of Cyclops, was distinctly seen in the living specimen, but can not be made out in the alcoholic specimens. One pair of short, obscurely jointed antennae were soon protruding beyond the anterior border of the head. The body is not clearly articulate but about eight constrictions of the body wall impart an articulate appearance. These constrictions divide the body into about eight segments, including the head. There is, then, first the head, whose breadth equals or even slightly exceeds its length, second, a neck-like segment, narrower than the head, cylindrical, the diameter about three-fourths the length, following this the third division of the body which is ovoid, enlarged its diameter more than three times the breadth of the head and its length equal to about one-third the entire length of the animal. Behind the enlarged segment are four cylindrical segments diminishing in diameter and slightly also in length posteriorly. The diameter of the first segment behind the enlarged part is about one-third the diameter of that part, the last, that is, the eighth segment, is anteriorly cylindrical and posteriorly divides into a forked tail, each fork being equal in length to the combined length of the preceding three segments and standing out at nearly right angles to the axis of the body.

From certain faint superhedral markings on the dorsum of the enlarged portion there is some reason for believing that it stands for at least three primary divisions of the body. On its anterior end also, there is a faint constriction, indicated in the sketch, which, if it were of equal distinctness with the other constrictions, would make a short segment, not enumerated in the foregoing. One of the smaller specimens when placed in glycerin showed a corresponding constriction in the intestine at this point. The other did not. Moreover, the intestine in it showed annulations anterior to this which did not have any corresponding annulations in the body-wall.

The color in life was whitish, the intestine dark-brown in its anterior portion. The alcoholic specimens are white, slightly tinged with yellow. The exterior wall moreover, is separated a little from the parts beneath, especially behind the enlarged portion, so as to look like a thin transparent envelope. The opaque inner part is studded with sharp-pointed elevations, giving a spinose appearance posteriorly (fig. 3). This appearance is presumably due to the shrinking of the inner part away from the outer wall. The latter is thin, transparent, and very little crustaceous.

On the under side of the head at its anterior end is a circular aperture within which could be distinguished a jointed appendage. This appears to be one, the left, of a pair of maxillae. There appeared to be three joints to this appendage and what was taken to be the basal joint of its fellow. There was some indication of an additional rudimentary pair of appendages in front of these. No anal opening could be made out on the large specimen at first, although a longitudinal mark on the ventral side of last segment, just at the bifurcation, probably represents it. Later it was made out, but was indistinct in the opaque specimen. The two smaller specimens which were not in first-class condition when they came into my possession, when put in glycerin showed the intestine apparently ending in an anus which was situated on the ventral side of the last segment just at the bifurcation and opening posteriorly.

Dimensions of large specimen in millimeters. Length 19, length of head 0.76, breadth of head 0.78, length of second segment 1, breadth 0.72, length of third segment 1.3, breadth 2.5, diameter of fourth segment 1.5, of seventh 1.5, average length of last five segments 1.2, length of antenna 0.21.

*Octobothrium denticulatum* Olsson.

[Plate 33, figs. 6-10, U. S. N. M. No. 6506. Bibring till Skandinavien Helminthofauna (1878), page 10, Plate I, figs. 13-17.]

A single specimen collected July 14, by Prof. H. M. Kelly, from the gills of the pollock (*Pollachius virens*) agrees closely with Olsson's species, whose synopsis I translate:

"Body depressed, ovate-oblong, tail large, assuming half the length of the animal, canaliculate, each plectanum bearing four pedicels, the pedicels short, cylindrical, their anterior valves extrinsically denticulate. Testes in the postero-medial part of the body near the tail. Ova with a filament at each extremity. Length 7 mm., breadth 2 mm."

The following notes were made on the alcoholic specimen: Head bluntly triangular; body lanceolate, slightly constricted behind the head; bothria a little longer than broad, approximating in length to subglobular pharynx. Anterior end for about 0.8 mm. and pedicels white, with tinge of yellow, also white spot in middle and white along mid line near anterior end; remainder of body dark brown. This for the dorsal side; ventral side same, but paler on the brown parts, and the mid line is white from the anterior end to about the level of the second pair of pedicels. Each pedicel appears to expand into a two-valved disc at the extremity, the valves being supported by a chitinous framework. There is a cluster of denticulate papillae on the anterior outer fourth of each disc, on what, when it is expanded, is its dorsal surface. Two dark-brown ova lay on the median line about 1 mm. back of the pharynx. These were oblong and had a slender filament at each end. The character of the filaments could not be made out exactly without mutilating the specimen.

Dimensions of alcoholic specimen in millimeters: Length 8; breadth, anterior 0.39, in front of pedicels 2, including pedicels 3.5; diameter of single disc 0.55; breadth of one of anterior bothria 0.14, length of same 0.16; breadth of pharynx 0.16, length of same 0.17; length of ovum not including filaments 0.19, breadth of same 0.07; length of single filament 0.14.

The cirrus, which is armed with a circle of fourteen bifurcate hooks, opens on the mid-ventral line 0.17 mm. back of the pharynx. The length of these hooks is about 0.02 mm. The arrangement of the reproductive organs could not be made out. The vitellaria fill up the greater part of the body, extending from the extreme posterior end, even going a short distance into the bases of the posterior pedicels, to within less than 1 mm. of the anterior end. The testis and ovary could be seen lying a little in front of the anterior pedicels, but they were so much hidden by the voluminous vitellaria that their outlines could not be made out.

*Epibdella bumpusii* sp. nov.

[Plate 34, figs. 11-15, U. S. N. M. No. 6509.]

My attention was first called to this beautiful and interesting form by Dr. Hermon C. Bumpus. Several specimens were obtained on August 18 from the exterior of the stingray (*Dasyatis centroura*).

Body flat and leaf-like, smooth, ovate, slightly constricted behind the anterior suckers, bluish-white and transparent. Anterior suckers crossed by about 22 ribs. Posterior sucker attached by pedicel at posterior margin of body, elliptical, the length slightly exceeding the breadth, armed with four hooks; the two anterior hooks straightish on the inner and convex on the outer margins, as seen in dorso-ventral view; the two posterior hooks longer, more slender and acenate, being curved toward the lateral margins. Pharynx subglobular. Testes two, about the middle of the body, on opposite sides of the median line, subspherical. Ovary a short distance in front of testes, triangular in outline. Vitelline reservoir immediately in front of ovary and a little toward the left. Reproductive apertures on left side of neck at marginal notch. Cirrus, uterus, and vagina open near together, the former being the most anterior and the others following in the order named. Larger part of the body occupied by the vitelline glands. Ova tetrahedral, with long, slender filament, ejected from uterus as fast as made.

Dimensions of living specimen, in millimeters: Length 12.5, breadth 8.35, breadth of posterior sucker 4.4, length of anterior sucker 1.25, breadth of same 0.34, breadth of pharynx 0.71. Other specimens were somewhat smaller. In a specimen mounted in balsam the length of the ventral sucker is 3.2, the breadth 2.4; the length of the longer hooks is 0.85, of the shorter 0.6. The length of the body of this specimen, exclusive of the ventral sucker, is 8, breadth 4.5.

Although somewhat aside from the main purpose of this paper, I append a few observations on the process of ovulation in this species, first as seen in operation in the living worm, and second as confirmed by a study of serial sections.

1 *The process of egg making in the living worm*—One of the lobes of the yolk reservoir appears to empty itself suddenly by a short duct into the common duct immediately in front of the ovary. Hence the mass of coarse granular yolk is seen to pass rapidly forward along the duct to the capsulo mold, where it is shaped into a tetrahedral form by the muscular walls of the mold. As soon as the mass of yolk reaches the mold the passage closes just behind the mold, where a comparatively solid base is formed, against which the mass of yolk is hunched into shape by the walls of the mold. At the same time the capsule is built round the mass of yolk. The material of which the capsule is formed appears to be secreted by what was interpreted to be the shell gland, which was situated about midway between the mold and the ovary.

It is not clearly evident where the slender filament was formed, although I thought I saw it lying in the spiral common duct, between the shell gland and the mold, just before the discharge of an egg. When the capsule is nearly finished a very small fine granular mass makes its appearance suddenly in the common duct at about the level of the shell gland. This mass, apparently injected into the common duct from the dorsal side, travels rapidly along the common duct, and is soon as it reaches the mold the completed egg is ejected forcibly by powerful contractions of the muscular walls of the mold. The duct through which it passes lies between the cirrus and the seminal receptacle. When an egg is not in transit this uterine duct is difficult to see, the walls being apparently nearly approximated.

The rush of yolk from the yolk receptacle to the common duct probably creates sufficient suction to draw a germ cell from the short communicating duct. Germs were distinctly seen in this duct and they were also seen to be set into oscillatory vibration when a mass of yolk was passing, but the yolk mass itself concealed the proximal end of the communicating duct so that no germ cell was actually seen to leave the duct to join the yolk mass, although when the latter reached the egg mold, a germ cell could occasionally be seen among the coarse yolk granules. The fine granular mass which joined the egg just before it was ejected was inferred to come from the seminal duct. This inference is apparently confirmed by structures revealed in serial sections as described below.

Egg making would proceed actively for some time, 10 minutes or more, then would follow a short period of rest. Unfortunately the time occupied in making an egg was not noted until the specimen had been under observation for 2 or 3 hours and had presumably lost much of its vitality. When noted the period occupied from the time when a mass of yolk left the reservoir until it was ejected as a completed capsule was about 40 seconds.

2 *Confirmation of some of the above-mentioned inferences*—Sections, both transverse and horizontal, were made of this interesting worm. The results were highly satisfactory, but the anatomical details are so numerous as to be altogether out of place in this report. I shall mention only certain details of structure which explain some of the phenomena of ovulation narrated above.

The duct which leads from the yolk reservoir passes dorsally (fig. 14, *gd*), hence can not be seen plainly, either in dorsal or ventral view, in the living specimen. The duct from the germ gland also has its outlet dorsally, and the two connect in such a manner that when a mass of yolk rushes along the yolk duct and into the common duct, a suction would be created which would tend to draw a germ from the germ duct. While the germ duct is spacious at its beginning in the germ gland, which feature indeed, could be seen plainly in the living specimen, where numerous ripe germs could be seen oscillating every time a charge of yolk passed toward the shell mold, the duct grows narrower distally, and at a short distance from the point of union with the yolk duct is but little wider than the diameter of a single germ. Since the amount of yolk which is necessary for a single egg is doubtless regulated by reflex nervous action, the whole apparatus has become adjusted with wonderful nicety, the sexual parts to each other, so that, when normal conditions prevail, just enough suction is created by the charge of yolk to draw a single waiting germ cell from the germ duct.

Another fact demonstrated by serial sections is that at a point but a short distance from the junction of germ duct with yolk duct, the common duct is joined by a small duct which was traced to the seminal receptacle. The latter is a thick-walled, muscular organ, lined with what in the sections look like cilia. It lies to the left of the other reproductive organs and has its external aperture, like them, at a notch on the left side of the head. The seminal duct is very much smaller than the vis deterens and does not strain so deeply with eunime. The vis deterens in these sections is very conspicuous and can be traced with ease from the testes forward in a somewhat tortuous course to the seminal vesicle at the base of the cirrus pouch.

This and kindred forms would well repay careful study and are commended to anyone who is in search of a thesis for research work.





*Distomum appendiculatum* Radolph (?)

[Plate 36, figs 23, 26, U S N M No 6511]

Two small distomii, associated with *D. dentatum*, from the flounder (*Paralichthys dentatus*) belong to the subgenus *Apoblenia* and appear to be near *D. appendiculatum*. The specimens, while quite small, are adult, each containing numerous ova. Collected August 27.

The following description is based on a mounted specimen. Body cylindrical, crossed by fine transverse striae about 0.005 millimeter apart. These striae are sharp and clear and make irregular outline at the margins, neck short, conical, conus beneath, mouth subterminal, acetabulum at base of neck about twice the diameter of the oral sucker. Both suckers acutely globular, seminal vesicle a short distance back of acetabulum situated toward dorsal side, between it and the acetabulum is the large prostate and cirrus pouch. The external reproductive aperture is on the midventral line very close to the mouth, cirrus smooth. The testes are two small subglobular bodies about 0.17 mm. behind the acetabulum, ventrally placed and lying diagonally near together on the median line. The vitellaria are two small but well-defined bodies lying ventrally, a little toward the right than front margins about half way between the acetabulum and the end of the body proper, the right lobe is subglobular, the left somewhat triangular. The folds of the uterus do not extend into the appendix, ovaries numerous, lying among the reproductive organs from behind the testes to the acetabulum, ovary globular, lying just in front of the vitellaria slightly dorsal to and touching them.

Dimensions of mounted specimen, in millimeters. Length with appendix 1.13, length without appendix 0.92, greatest diameter 0.25, diameter of oral sucker 0.065, diameter of acetabulum 0.12, length of pharynx 0.05, diameter of pharynx 0.04, longer diameter of ova 0.027, shorter diameter of ova 0.014.

It will be noticed that while the proportions of the suckers are those of *D. appendiculatum* the character of the vitellaria shows a dissimilarity to that species.

*Distomum fecundum* sp. nov.

[Plate 36 figs 27-35, Plate 37, figs 36, 37 U S N M No 6512]

On September 1 the viscera of five teleost fish (*Lopholatilus chamaeleonticeps*) taken in 75 fathoms of water, south of Newport, R. I., were placed in formalin. On September 5 I examined these viscera for entozoa, finding but few, and only one specimen of *Distomum*.

The specimen being too thick to permit of a satisfactory examination of the internal structure, it was cut into transverse sections. A study of these yielded such interesting results that I feel justified in recording the following description. Body unannexed, smooth save for transverse wrinkles probably due to contraction, thick, bluntly rounded in front, squarish posteriorly, neck slightly excavate beneath, mouth subterminal, circular, acetabulum much larger than oral sucker, sessile, prominent, its aperture a transverse slit, pharynx subglobular, oesophagus very short, branches of intestine simple, extending to posterior end, genital aperture in front of acetabulum a little to right of median line, cirrus and pouch for the greater part dorsal to acetabulum, seminal vesicle dorsal on left side just in front of ovary, vas deferens accompanied by prostate from seminal vesicle to cirrus also dorsal, ovary dorsal back of posterior third on median line, testes two, transverse, the right a little in advance of the other, following the ovary posteriorly, but situated more ventrally than ovary.

In sections proceeding from the head the right testis appears soon after the ovary is first seen, and continues to show in sections after the ovary has disappeared. The shell-gland is ventral to the ovary. Vitellinae not abundant in this specimen, which is adult, situated along the dorso-lateral regions of the body from the testes to the posterior edge of the acetabulum. The excretory vessels are traced from the terminal pore, as a single narrow median canal, to a point in front of the ovary, where it divides the two branches passing one on either side of the acetabulum ventral to the intestine. The most conspicuous organ in this specimen is the uterus. Its folds fill the body from the posterior end to the acetabulum. Both behind and in front of the ovary and testes the uterus occupies the whole cavity, save the small places occupied by the intestinal branches and excretory vessels. The ova of which there are immense numbers, are small oblong-elliptical in outline, with thin shell. The contents of a great many of them were stained deeply with carmine. Many of them were broken open in the same manner at one end as if a natural line of cleavage existed there, causing a terminal cap like part of the shell to separate. The cells which line the intestinal tract are long and project into the lumen with their bluntly rounded and slightly enlarged ends.

Dimensions in millimeters. (1) Specimen entire in oil of cedar. Length 2.75, breadth through



anterior sucker 1, breadth through acetabulum 1.25, breadth at posterior fourth 1.4, distance between suckers 1.1, thickness behind acetabulum 1.1, thickness at acetabulum 1.6; (2) from sections, transverse diameter of oral sucker 0.65, vertical diameter of same 0.47, transverse diameter of pharynx 0.31, vertical diameter of same 0.28, length of same (estimated) 0.28, transverse diameter of acetabulum 1.08, vertical diameter of same 0.65, greater diameter of ova 0.031 to 0.041, lesser diameter of ova 0.017, transverse diameter of ovary 0.48, vertical diameter of same 0.24, length of same (estimated) 0.30.

Some of the details of structure are shown in the sketches, figs. 29-37.

*Distomum vitellosum* sp. nov.

[Plate 37, figs. 38, 39, U. S. N. M. No. 6513.]

Three small distoma associated with others referred to *D. creatum* Molin, in the lake (*Merluccius bilinearis*), collected August 29, are here described. They were distinguished from the others at the time of collecting by their slender conical necks, very prominent acetabulum, relatively large ova, and having the posterior part of the body filled with subangular vitelline masses.

The species is probably new. It would seem to be a member of a group of species of which *D. umbrium* Stossich, *D. oboratum* Molin, and *D. wormyi* Stossich are representatives. The characters, so far as they can be made out from my specimens, are: Body smooth, subcylindrical; neck short, slender, conical, very contractile in life, in preserved specimens arched above, concave and hollowed out beneath; mouth subterminal, aperture transverse; pharynx, immediately following oral sucker, elongated; oesophagus not made out, but either none or very short; branches of intestine simple, not spacious, extending to near the posterior end; acetabulum much larger than oral sucker, prominent, aperture contracts to small, transverse opening with puckered margins, situated about anterior third in preserved specimens. Aperture of reproductive organs in front of acetabulum, on left of median line; testes two, moderately large, median, approximate, and situated near posterior end; ovary in front of anterior testes and touching it, lying on median line, but a little toward the right; vitellaria consisting of numerous rather large subangular masses, which fill the body behind the testes and extend along the sides as far forward as the acetabulum; ova not numerous and rather large, lying between ovary and acetabulum.

Dimensions in millimeters: (1) Of a specimen in glycerin, length 1.42, diameter of oral sucker 0.08, diameter of acetabulum 0.25, longer diameter of ova 0.052, shorter diameter of ova 0.031; (2) of a specimen in balsam, length 0.88, diameter of anterior sucker 0.10, diameter of acetabulum 0.17, greatest breadth of body 0.25, length of neck 0.23, longer diameter of ova 0.058, shorter diameter of ova 0.031.

*Distomum padens* sp. nov.

[Plate 37, figs. 40-47, U. S. N. M. No. 6514.]

Certain distoma from the common flounder (*Paralichthys dentatus*) collected September 5 were thought at first to be identical with *Distomum* sp. from the same host, described on page 290; but when examined more closely were found to be different. The alimentary canals of four flounders were washed out and, after repeated washing and decanting, a large number of distoma were obtained. These are of various shapes and sizes, but appear to belong to the same species. The largest when living measured from 2.7 to 3.7 mm. in length, with maximum breadth of about 0.8 mm. One of the smaller specimens measured 1.2 mm. in length and 0.42 mm. in breadth.

The following description is based on preserved material: Body smooth, ovate to linear oblong, somewhat depressed; neck variable, conical, tapering to mouth, or often shortened by inversion of anterior end; mouth terminal, unarmed; oral sucker nearly circular in outline, i. e., when viewed either from the dorsal or ventral side, and considerably larger than the oral sucker, situated not far from the anterior fourth; pharynx pyriform, with the posterior end the larger, proportions not uniform. In some cases the length is greater than the breadth, in some it equals the breadth, and in some it is less than the breadth; separated from the oral sucker by a distance equal to a little more than its own length and from the intestinal caeca by a distance less than half its length. These proportions are for a specimen in which the neck is extended. When the anterior end is inverted, or even slightly contracted, the pharynx may follow the oral sucker very closely and appear to open directly into the intestinal caeca. The walls of the intestine are very thin; the intestinal caeca are simple and extend to the posterior end of the body. The excretory vessel was seen to be spacious and thin-walled at the posterior end, but was not seen in anterior part of the body. It should be noted that the specimens had lain overnight in water before they were placed in killing and hardening fluid.

Testes two, rather large, median, approximate, inferior testis nearly circular in outline when seen from dorsal or ventral surface, the posterior testis a little longer than broad, seminal vesicle large, situated toward the right side at base of cirrus pouch, in which it is partly included, behind acetabulum, but passing, with cirrus pouch dorsal, to acetabulum to the right, the cirrus, which is a conspicuous organ, opening beside the uterus, just in front of the acetabulum, spines were noted in sections of what in an ovulated cirrus would be the somewhat bulbous base, or very globular, much smaller than testis, approximate to anterior edge of anterior testis and on the right of the median line, the vitellaria consist of numerous small bodies, which lie along the lateral margins and at the posterior end, they extend laterally into the neck of the pharynx, uterus from genital aperture passes back on left side of acetabulum dorsally to folds of uterus, which lie between the anterior testis and acetabulum and contain rather large, not numerous ova.

A large number of measurements were made of mounted specimens, and considerable variation was found in the proportions of even such usually constant organs as the suckers and pharynx. Dimensions in millimeters: (1) Of sectioned specimen, length 2.71, greatest breadth 0.57, oral sucker, length 0.14, breadth 0.18, acetabulum, length 0.21, breadth 0.21, pharynx, length 0.16, breadth 0.13. (2) Of a mounted specimen, length 1.6, oral sucker, length 0.076, breadth 0.111, acetabulum, length 0.135, breadth 0.133, pharynx, length 0.088, breadth 0.076. Length diameter of ova in sectioned specimen 0.055, shorter diameter 0.035, ova in a specimen cleared up in acetic acid measured 0.069 in the longer and 0.035 in the shorter diameter.

The specimens agree very closely with *D. fasciatum* Rudolphi, but differ in the ratio of oral sucker to acetabulum. In *D. fasciatum* the acetabulum is double the diameter of the oral sucker, furthermore, the esophagus, i. e., that portion of the alimentary canal between the pharynx and the intestinal caecum, is represented as longer than the pharynx, and the pharynx as following the oral sucker directly. In *D. patens* the diameter of the acetabulum while greater than that of the oral sucker, is not twice as great, and the pharynx is followed by a very short esophagus, while it is separated from the oral sucker by a distance about equal to its length, except in cases of involution of anterior end.

#### *Distomum vibex* sp. nov.

[Plate 28, figs. 48-51. U. S. N. M. No. 5315.]

The following description is based on alcohol specimens collected by Dr. F. P. Colburn, June 11, from the smooth puffer (*Spharodon maculatus*), pharynx and intestine. Body unarmored, subuniloculate, thick, convex above, neck concave beneath, acetabulum much larger than mouth aperture transverse, in most cases retracted, with part of the adjacent body wall drawn into its interior, mouth subterminal, aperture circular, pharynx subglobular, contiguous to oral sucker, esophagus short, intestinal caecum simple, extending to posterior end of body, excretory vessels large, testes two, lateral, behind acetabulum and in front of the folds of the uterus, ovary subglobular, in front of testes, dorsal, vitellaria lateral and posterior, extending forward to the acetabulum, genital aperture behind the pharynx near the median line.

This species resembles *D. jellies* Olsson, but differs especially in the position of genital aperture. The specimens vary from 1.25 to over 6 mm. in length. Many of the larger ones are transversely wrinkled. The smaller ones are smooth, and all present a plump appearance. Many of them had become fastened together, probably at the time of immersion in the killing fluid, the acetabulum of one adhering so strongly to another as to pull a part of body into a prominent knob.

The following gives dimensions, in millimeters, of a large and small specimen, alcohol.

Measurements	Large specimen	Small specimen
Length	6.00	1.34
Diameter of oral sucker	1.00	0.37
Diameter of acetabulum	1.60	0.60
Greatest breadth	2.60	0.70
Breadth of oral sucker	0.55	0.13
Length of oral sucker	0.54	0.32
Breadth of acetabulum	0.38	0.60
Length of acetabulum	0.49	0.60
Distance between suckers	1.60	0.75
Greatest thickness of body	2.09	0.61
Length diameter of ovum	0.53	
Shorter diameter of ovum	0.33	

Sections of both the large and the small specimens were made, and while it does not enter into the plan of this paper to give histological details, the following anatomical details may be here recorded for purposes of identification: The cuticle is thick, particularly its inner layer, which presents a crenulate outline. Both longitudinal and circular muscles strongly developed, especially the former, and in the neck transverse fibers are very abundant. The submuscular cell layer is very conspicuous. The pharynx is about half the length of the oral sucker, and opens into the intestinal caeca by a very short oesophagus. The acetabulum is strongly developed, and evidently functions as a powerful suction organ. In all the specimens sectioned it had drawn in a part of the tissues constituting the ventral portion of the base of the neck, while the cavity of the acetabulum contained material which appeared to be pieces of the intestinal mucous membrane of the host. The branches of the intestine lie dorso-laterally, and reach to the posterior end of the body. On account of the state of contraction of the body, the intestinal walls are much convoluted. The cells lining the intestine are large and the ends turned toward the lumen are swollen and stain very slightly with carmine.

The excretory vessels were traced forward to the oral sucker and back to the posterior end, where they unite. The vessels are large, their walls thin, granular inner surface staining deeply with carmine. Near the posterior end the walls become somewhat thickened and appear much folded. The ovary is in front of testes, toward the dorsal side and close behind the acetabulum. Some of the sections indicate an obscurely lobed structure. The shell gland lies on the ventral side of the ovary and immediately behind the acetabulum. The uterus, beginning at the shell gland just behind the acetabulum, fills the posterior part of the adult body with its voluminous folds. It leads forward on the dorsal side of the acetabulum, and in front of that organ passes ventrally beside the cirrus pouch, the external genital aperture being on the ventral side of the neck, a little to the right of the median line in one specimen, a little to the left in another, and, as near as could be determined in these highly contracted specimens, approximately about the anterior third of distance between the two suckers. The testes are two, laterally placed behind the ovary and ventrally, and near enough so that some of the transverse thin sections of the body passed through both the testes and the ovary.

The seminal vesicle lies immediately in front of the acetabulum. It is inclosed in a spherical muscular sac, but it and the vas deferens, cirrus, and prostate gland all are inclosed in a special sac. This is partly shown in the sketch, fig. 10, p. 31. No posterior seminal receptacle was made out.

The vitelline glands are conspicuous voluminous organs lying laterally and posteriorly rather more ventral than dorsal. They appear to consist of numerous branching glands which extend forward to the posterior edge of the acetabulum. In sections stained lightly with carmine these organs are beautifully differentiated as golden-brown bodies with parts stained red with the carmine. Both ovary and testes stain strongly in carmine.

#### *Distomum pyriforme* sp. nov.

[Plate 38, figs. 52-59, U. S. N. M. No. 6316.]

These distoma were found on four occasions, August 10, 19, 22, 25, in enormous numbers in the pyloric caeca of the rudder-fish (*Palliarichthys periformis*).

Body very slightly compressed, of various shapes, but usually elliptical or pyriform in outline, armed with low, flat, rounded, scale-like spines. Neck in some slightly extended; in others the oral sucker was retracted (fig. 56). Mouth subterminal, orbicular. When the worm is extended so as to give a favorable view the oral sucker is slightly elongated and separated from the pharynx by a short oesophagus. The latter, of course, is difficult to make out in contracted specimens. Acetabulum a little broader than long, about equalling the oral sucker and situated about the middle of the length of the body. Intestinal branches conspicuous, straight, reaching to the posterior end of the body. Testes two, nearly globular, but breadth slightly greater than length in elongated and considerably greater in contracted specimens, situated well toward the posterior end, close together, one immediately in front of the other. Cirrus pouch elongated, on right side of acetabulum opening in front of the same; cirrus spinose. Ovary small, round, situated in front of the testes near the seminal vesicle, dorsal, and a little toward the right and close to the acetabulum. Vitellaria voluminous, filling the greater part of the body, especially at the posterior end and along the lateral margins as far forward as the acetabulum. Uterus evidently short, ova very few and relatively large, lying between ovary and acetabulum and equalling in length the diameter of that organ.

The following table gives the dimensions in millimeters.

Measurements	No 1	No 2	No 3
Length	0.71	0.72	0.76
Breadth	.19	.12	.18
Length of oral sucker	.06	.048	.072
Length of acetabulum	.06	.041	.057
Length of acetabulum	.055	.018	.048
Breadth of acetabulum	.063	.041	.072
Length of pharynx	.031	.071	.018
Breadth of pharynx		.027	.031

No 1 was a living specimen, slightly compressed, Nos 2 and 3 were mounted in balsam. A specimen free in sea water measured 0.36 mm in length contracted and 0.57 mm when extended. The ova measured 0.035 and 0.031 mm in the two principal diameters.

The following measurements of living specimens show the various shapes assumed by these worms.

Length	0.28	0.46	0.43	0.21	0.25	0.74	0.16	0.45
Breadth	0.20	0.17	0.21	0.11	0.14	0.09	0.10	0.17

Sections were made of some of the pyloric caeca and revealed numerous distomata embedded in the contents of the caeca (fig. 52). Spherical bodies with a concentric structure were seen lying in the excretory vessel. These masses were not of uniform size; the largest measured 0.01 mm in diameter. They appear to be solid excreta. They are much smaller than the ova and moreover are spherical. In those sections it was seen that the oral sucker and acetabulum are of substantially the same size. One of the larger specimens, which lay in a favorable position, yielded the following measurements (in millimeters) of these parts: Diameter of oral sucker, 0.07, of acetabulum 0.07, diameter of pharynx, 0.01, length of body, 0.35; breadth, 0.24.

A large portion of the preserved specimens have the anterior end of body inverted. There is thus the greatest variety of outline exhibited by these specimens, long and short oval, sublinear, elliptical, and pyriform, the latter in some form or other perhaps predominating. The excretory vessel appears to be large and was seen to expand into a spacious posterior area in some instances (fig. 55). In the sections the cirrus was seen to be spinous and the seminal vesicle and prostate were relatively large. The genital aperture is in front of the acetabulum and apparently near it. The ova are few, usually three or four—in one case six were seen—but as compared with the size of the worm are very large.

No attempt was made to estimate the numbers of these distomata in a single host. In the first instance the pyloric caeca were seen to be minutely punctured with dark specks. When they were placed in a small dish of sea water and examined with a hand lens immense numbers of small distomata were seen on the pyloric caeca. The sketch of a part of a section of the pyloric caeca (fig. 52) gives an imperfect idea of the great numbers of these parasites. When it is remembered that this is what is shown in a very thin section and that a long series of sections revealed a similar degree of infection throughout the caeca it may be inferred that the vitality of the host is affected seriously by their presence.

#### *Distomum areolatum* Radolphi

[Plate 20, figs. 46-51, U. S. N. M. No. 6617.]

Some small distomata, found in a dish in which viscera of the white perch (*Morone americana*) had been lying, are referred, not without some doubt, to this species. The following description is based on a mounted specimen. Body covered with short, flat spines, which appear slender on the margins, probably because there seen on edge. The spines become somewhat aciculate posteriorly, but with care may be traced nearly if not quite to posterior end. The body is depressed ovate and broadest toward posterior end. The anterior sucker is annular, ovate, with circular aperture, subterminal and a little larger than the acetabulum. The latter is sessile, broader than long, and situated about the anterior fourth of the body. Pharynx oblong, shorter than the oral sucker. Oesophagus very short, shorter than pharynx. Branches of the intestine simple, extending nearly to the posterior end. Excretory vessel spacious, at posterior end of the body. Testes, two rather large bodies placed side by side on opposite sides of the median line, with their anterior borders about the middle of the body. The cirrus pouch lies back of the acetabulum and to the right.

The reproductive aperture is in front of the acetabulum. The ovary is subglobular and lies on the left of the median line and is separated from the acetabulum by the uterus with a few—three or four—large ova, and the shell gland. The latter lies just back of the acetabulum. On the right side of the median line and at about the same level as the ovary is the posterior seminal receptacle. Just back of the seminal receptacle and ovary, and lying across the median line, is a lozenge-shaped mass of vitelline substance, apparently a yolk reservoir, with ducts leading to the right and left to the voluminous vitelline glands. These glands occupy the lateral margins of the body from the posterior end to the pharynx.

Dimensions in millimeters: (1) In sea water, length variable, but from 0.7 to 0.9; breadth 0.4; oral sucker, length 0.10, breadth 0.12; acetabulum, length 0.10, breadth 0.09; ova, longer diameter 0.11, shorter diameter 0.07. (2) Specimen mounted in balsam, length, 1.3; greatest breadth 0.61; diameter of oral sucker 0.17; diameter of acetabulum 0.13; length of pharynx 0.28; breadth of same, 0.23; distance between suckers (margin) 0.14. In one case where the acetabulum was 0.10 long and 0.11 broad, an ovum measured 0.117 and 0.076 in the two principal diameters.

*Distomum dentatum* sp. nov.

[Plate 20, figs. 61-67, U. S. N. M. No. 6316.]

A few small distomes from the Bonnetter (*Paralichthys dentatus*), resembling in many important particulars the species which I have called *D. leucae* (Proc. U. S. Nat. Mus., vol. xx, p. 535, pl. 141, figs. 2-8), are here included.

The following description is based mainly on specimens mounted in balsam: Body somewhat depressed, increasing in breadth toward posterior end, the proportions varying with different stages of contraction, but posterior end usually bluntly rounded, greatest diameter usually at the posterior testis; neck short, conical, cylindrical in front, somewhat depressed at base; neck and body covered with short, subtriangular, scale-like spines, which are densely placed anteriorly, but become scattering at posterior fourth and very sparse at posterior end; ventral sucker sessile, larger than oral sucker, nearly circular in outline, with transverse aperture, situated about the anterior third, though in some cases where the neck was contracted the suckers were closer together and the acetabulum was then in advance of the anterior third; mouth terminal, surrounded by double circle of straightish spines, about 24 in each circle, the spines of one circle alternating with those of the other; the oblong pharynx is separated from the oral sucker by a distance approximating its own length, lies close to the front edge of the acetabulum, and opens directly into the intestine.

The branches of the intestine extend to the posterior end of the body. The cirrus pouch, with the inclosed seminal vesicle, lies behind the acetabulum and a little to the right. The cirrus passes along the right dorsal edge of the acetabulum, while the distal end of the uterus passes on the dorsal left edge of the same, both coming together at the reproductive aperture in front of the acetabulum, about on the median line. Behind the cirrus pouch and in front of the ovary is the uterus, containing a comparatively small number (40 estimated in one) of ova. The ovary lies a little to the right of the median line, immediately in front of the anterior testis, appearing somewhat triangular in outline. The testes are two, large, quadrangular in outline, broader than long, median, approximate, the junction between them not far from posterior third of the body. The vitellaria are very abundant, massed posteriorly, along the lateral margins even into the neck, and around the periphery of the body over the other organs.

Dimensions, in millimeters:

(1) Living specimen: Length 1.14, anterior diameter 0.14, median breadth 0.37, diameter of oral sucker 0.08, diameter of acetabulum 0.14, longer diameter of ovum 0.07, shorter diameter of ovum 0.03.

(2) Specimen mounted in balsam: Length 1.85, anterior diameter 0.17, greatest breadth 0.61, diameter of oral sucker 0.14, diameter of acetabulum 0.20, length of pharynx 0.14, diameter of pharynx 0.10, length of anterior testis 0.21, length of posterior testis 0.28, breadth of each testis 0.31, longer diameter of ovum 0.06, shorter diameter of ovum 0.03, length of longest oral spines 0.04.

When these specimens are compared with *D. leucae*, besides being considerably smaller they are relatively broader and much more appressed. The number of oral spines is different, although this difference should not be made much of, since observations on a great number of specimens are needed to determine what variations, if any, occur in this respect in these species.



*Distomum flagale* sp. nov.

[Plate 19, figs 68-70, U. S. N. M. No. 6519.]

Several small distomes were found in the intestines of a sun fish (*Mola mola*) on July 19. On account of their inconspicuous size, and because of the large amount of other material which was collected at the same time, these specimens were not given as much attention at the time of collecting as they deserved. Upon going over the preserved material I find that it is not in perfect condition, the delicate parts of the specimens having broken in every case.

The following description is based entirely on preserved material. Body unarmed fusiform from acetabulum back, depressed, neck elongated, slender, cylindrical, slightly enlarged at mouth. Acetabulum a little longer than mouth, subglobular, at base of neck sessile, mouth terminal or nearly so. Pharynx subglobular, situated a distance equal to twice its length or more behind the posterior edge of the oral sucker, followed by a slender oesophagus, intestinal caeca simple, beginning in the neck about half way between the pharynx and acetabulum, extending to near the posterior end of the body, testes two, median, approximate, situated near the posterior end of the body, a little longer than broad, ovary subtriangular in outline, lying immediately in front of the anterior testes and a little to the right, cirrus and cirrus pouch immediately in front of the acetabulum and to the left, vitellina very abundant, appearing in subangular masses at posterior end and along dorsal and lateral regions of the body to and even in front of the acetabulum, uterine follicles between acetabulum and ovary, oval relatively large and in moderate number.

Dimensions of mounted specimen, in millimeters. Length 1.78, diameter of anterior sucker 0.10, diameter of neck behind mouth 0.07, diameter at acetabulum 0.21, greatest diameter 0.33, distance of acetabulum from anterior end 0.71, diameter of acetabulum 0.14, length of testes 0.17, breadth 0.14, diameter of ovary 0.10, longer diameter of cirrus 0.060, shorter diameter 0.038, length of pharynx 0.06, distance between pharynx and anterior sucker 0.15.

The excretory vessel was not noted until sections were reached back of the testes, where it becomes a somewhat spacious vessel. The posterior seminal receptacle is situated immediately dorsal to the ovary. In the sectioned specimen the testes were seen to occupy the whole height of the body cavity. In the vicinity of the testes the vitellina were seen to lie along the lateral margins, on the dorsal side mostly to the median line, and on the ventral not quite so far. Behind the testes they extend entirely around the cavity in which lie the two intestinal caeca and the centrally placed excretory vessel.

*Distomum* sp.

[Plate 19, fig. 71, U. S. N. M. No. 6520.]

Brief mention is here made of a *distomum*, three examples of which were obtained from the sea robin (*Prionotus carolinus*) August 21. Two specimens of fish were examined. The alimentary canal was opened and washed out in water, with the result given above. My notes, made at the time, characterize these worms as having the head and prominent acetabulum transparent and colorless, the body opaque, white, yellowish behind the acetabulum, neck very short, sessile, body cylindrical and slightly irregular.

Dimensions, in millimeters, of a specimen in sea water. Length 1.06, length of oral sucker 0.07, breadth of same 0.11, length of acetabulum 0.18, breadth of same 0.21, diameter of neck at narrowest point 0.13, diameter of body 0.26, dorso-ventral diameter of body, including acetabulum 0.31, same behind acetabulum 0.17, same of neck 0.13, length of neck 0.13. The length of another specimen was 1.78. In a mounted specimen the pharynx measured 0.09 in length and 0.07 in diameter, and the ovary 0.048 and 0.051 in the two principal diameters.

Following are the specific characters, so far as I have been able to make them out.

Body unarmed, ovoidate, nearly cylindrical, neck short, cylindrical arising in position from ventro to semioacetabulum pedicellate about twice the diameter of the oral sucker, mouth terminal, oesophagus none or very short, branches of the intestine simple, extending nearly to the posterior end, testes two, median, juxtaposed, dorsal, ovary immediately in front of the testes, globular, ventral, vitellina conspicuous, extending from the posterior extremity to the acetabulum, follicles of the uterus between the ovary and acetabulum, oval rather large and not very numerous, reproductive openings immediately in front of the acetabulum.

These specimens possess many characters common to the forms which I have referred doubtfully to *D. amplius* Rudolphi. (From *Die Parasiten der Fische*, p. 527.)



*Distomum* sp.

[Plate 39, fig. 72; Plate 40, figs. 73-75.]

Among the numerous small distoma found during the summer of 1898, I note briefly a form found on two occasions, but as only a single specimen was obtained in each case formal identification has not been attempted. Both are characterized by having the body armed with minute, scale-like spines, dense on the neck, but becoming sparse posteriorly on the body. One was obtained from a scup (*Stenotomus chrysops*) August 15, the other from a flounder (*Paralichthys dentatus*) August 25. Since the stomach of the latter contained several small scup, and the distomum was obtained by washing out the alimentary canal of the flounder, the true host of the worm is quite probably the scup.

Dimensions of living specimens, in millimeters:

(1) Specimen from scup: Length 0.52, greatest breadth 0.31, diameter of oral sucker 0.06, of acetabulum 0.09, longer diameter of ovum 0.076, shorter diameter of same 0.034.

(2) [U.S.N.M., No. 5521.] Specimen from flounder: Length 1, greatest breadth 0.53, diameter of oral sucker 0.18, of acetabulum 0.18, longer diameters of ova 0.076, shorter diameter of same 0.052. The same specimen mounted in balsam is 1.22 in length and an ovum measured 0.064 and 0.034 in the two principal diameters.

Diagnostic characters, so far as they can be made out from the latter specimen, are as follows: Body ovate, depressed, whitish in life, covered with short scalelike spines becoming sparsely scattered posteriorly; neck short with tendency to be constricted behind oral sucker; mouth subterminal; acetabulum equalling or slightly exceeding mouth; pharynx longer than broad; esophagus none; branches of intestine, simple, apacious, extending to near posterior end; testis two, median, back of middle of body, close together, relatively large, broader than long; genital aperture in front of acetabulum, a little to the left, cirrus pouch behind acetabulum; ovary subglobular lying immediately in front of anterior testis; uterine folds, containing a few (6) relatively large ova, lying between the ovary and acetabulum; vitellaria along lateral margins from the posterior end to acetabulum.

*Immature Distoma encysted in skin of Cunner.*

[Plate 40, fig. 76-81, U. S. N. M. No. 5522.]

A cunner (*Tautoglabrus adspersus*) was examined September 5, in which the general surface of the body, including the fins, was covered with minute cysts. The appearance of the fish agreed in minutest detail with Ryder's description of a similar case observed by him (Bulletin U.S. Fish Commission for 1884, pages 37-42). Black pigment cells are very abundant in the vicinity of the cysts, where they make black, opaque masses immediately surrounding the cysts. Pigment is almost entirely absent from the exterior surface of the cyst where the epidermis is tightly stretched. The cysts themselves are nearly transparent. This is true for the larger cysts. The smaller cysts have pigment cells over their surface, but in no greater abundance than normal. As the cysts grow, the pigment cells retreat from the surface and accumulate about the periphery of the cysts as it is seen in optical section when a scale with these cysts is put under a cover glass and examined with aid of a microscope. The red pigment of the skin continues to be represented over surface of cysts longer than the black. In all cysts observed pigment cells were absent from surface just above the young worm.

Ryder thought these cysts were due to the presence of the cercaria of some trematode. He does not appear actually to have seen them. Some of the young removed from the cysts proved to be young distoma, thus confirming the general conclusion of Ryder.

Sections were made of the fins containing numerous cysts, but without throwing any light on the probable identity of the adult species represented by these immature forms. The walls of these cysts, as seen in section, prove to be relatively thick. In one which measured 0.32 by 0.25 mm. in the two principal diameters the wall of the cyst was 0.05 mm. thick.

The following table gives the dimensions, in millimeters, of living specimens removed from cysts:

Measurements.	No. 1.	No. 2.	No. 3.
Length.....	0.70	0.82	0.47
Maximum breadth.....	0.17	0.20	0.17
Breadth of anterior sucker.....	0.06	0.06	0.05
Length of pharynx.....	0.048	0.04	0.041
Breadth of pharynx.....	0.035	0.034	0.021
Breadth of acetabulum.....			0.045

Diameter of a single cyst, 0.56, not including the surrounding pigment.

## Cysts with Trematode Ova

[Plate 10, figs 82-81 U &amp; N M No 6-27]

Three specimens of white perch (*Morone americana*), examined on August 27, had the viscera generally covered with pigment patches. A study of these not only verified observations of a similar nature published by me in vol XX, *Proceedings of U. S. National Museum*, page 577, but confirmed certain conclusions reached with regard to some waxy masses found in a disk used over eye of this fish.

In the specimens ova were found (1) with cyst just beginning, (2) with thick cyst of connective tissue, (3) cyst and ovum both surrounded with a waxy secretion, but ovum still plainly visible, (4) waxy mass similar in appearance to (3) but with no ovum visible, (5) masses of very dark-brown, almost black, pigment. The ova were not of uniform size, the largest, however, measured 0.025 mm and 0.013 mm in the two principal diameters shown in optical section.

Sections of the liver were made, but no pathological features were noted further than presence of ova in pigment patches, of which there were a large number in the serous coat of the liver. 100 ova were estimated in a single section through one of these pigment patches, which would indicate approximately 1000 ova in the pigment patch.

*Gasterostomum ovatum* J f[*Monostomum orbiculare* Rudolphi Linton Proc. U. S. N. M., vol XX, pp 511-512 Pl. I IV, figs 2-5, U & N M No 6872]

The specimens from *Labridae surinamensis*, referred by me to the genus *Monostomum*, belong to the genus *Gasterostomum*. As they appear to be new, I propose the name *Gasterostomum ovatum* for this species and give the following emended definition.

Body ovate, depressed, flattened ventrally, convex dorsally. Acetabulum subterminal a little broader than long. Mouth [fig 3, ph. loc. cit.] at about anterior fourth of body. The mouth is easily overlooked. When a specimen is placed in a transparent medium a subglobular pharynx is seen, in appearance like a small ventral sucker. Vitellaria arranged in a somewhat semicircular band between the mouth and acetabulum along the right side as far as the first testis, and along half the length of the left side. Testes two, subglobular on the right side back of the mouth, and one following the other closely. Ovary globular in front of testes and beside the mouth. Uterus voluminous, crowded with small, nearly globular ova, its folds lying along the left side and midventral line from a point a little in front of the mouth to near the posterior end, where there is a large roundish mass of ova, which in ventral view usually obscures the oblong ovio-ovine pouch. The latter lies near the mid-ventral line, its base on a level with the posterior edge of posterior testis. The external genital aperture is at the posterior end.

Additional measurements, in millimeters: Length 1.91, greatest breadth (at mouth) 0.92, length of acetabulum 0.17, breadth of same 0.2, breadth of mouth 0.07, diameter of oral sucker (pharynx of original description) 0.14, length of anterior testis 0.23, breadth of same 0.21, length of posterior testis 0.21, breadth of same 0.23, diameter of ovary 0.17, diameter of ova (average) about 0.017, distance between acetabulum and mouth (centres) 0.56.

*Gasterostomum arcuatum* sp. nov.

[Plate 11, figs 85-90, U &amp; N M No 6284]

On two occasions small trematodes were found in the gonito (*Gavia eschscholtzii*)—July 20 numerous, August 8 few—in pyloric area and intestine. In the living worm the color of the lateral margins is translucent white, anterior yellowish white, posterior yellowish brown where the ova show through the body wall, neck very changeable, contracting and extending incessantly. These prove to belong to the genus *Gasterostomum*.

The following description is based on preserved specimens. Body slender, cylindrical, tapering gradually to anterior end, acute, posterior end bluntly rounded, covered with minute, low, flat spines, which are dense in front and throughout the greater part of the length of the body, inferior sucker terminal with circular aperture, ventral sucker (mouth) situated a little in advance of middle, smaller than anterior sucker, globular, aperture subterminal, intestine short, soon expanding into a

pouch which has a triangular outline, when seen in lateral view, immediately in front of and dorsal to the ovary; testes two, subglobular, the posterior one about midway between the ventral sucker, the anterior midway between the posterior testis and the ventral sucker. The ovary is slightly smaller than the anterior testis and lies in front of it and approximate. The cirrus lies ventrally at the posterior end. It has very thick walls and extends anteriorly to the posterior testis. The vitellaria consist of about 32 conspicuous globular, yellowish-brown masses, which lie for the most part anterior to the ventral sucker. In a specimen which was compressed lightly and viewed from the dorsal side these bodies lay in an irregular double lateral line, 16 on each side. About three of these lateral masses were posterior to the ventral sucker. The remainder extended forward to a point nearly midway between the anterior and the ventral sucker. The folds of the uterus are very voluminous, filling the posterior part of the body and hiding the other organs as far forward as first testis. Ova very numerous, small, size somewhat variable, but average about 0.021 mm. and 0.014 mm. for the two principal diameters.

The following measurements, in millimeters, were obtained from a living specimen: Length, 1.28; diameter anterior sucker, 0.09; diameter at anterior end, 0.01; median diameter, 0.21; diameter at posterior end, 0.14. In a mounted specimen measuring 2.7 mm. in length, the diameter of the anterior sucker was 0.1, the diameter of the ventral sucker was 0.07. In this specimen the ventral sucker was 1.3 mm. from the anterior end, and the length of the cirrus was 0.7 mm. A spacious, thin-walled vessel lies in the anterior part of the body, terminating blindly a short distance back of the anterior sucker, which I take to belong to the excretory system.

*Gasterostomum* sp.

[Plate 41, figs. 51, U. S. N. M. No. 6525.]

A single specimen from the gar-fish (*Tylosurus marinus*), August 27, is here mentioned. The body is so full of ova that details of the anatomy can not be made out satisfactorily. The body is ovoid tapering uniformly from about the middle to each extremity.

The following dimensions are given in millimeters:

(1) In sea water: Length 0.85; diameter, anterior, 0.14; greatest diameter, near middle, 0.43; diameter, posterior, 0.17.

(2) Specimen mounted in balsam, length, 0.92; greatest diameter, 0.5; length of acetabulum, side view, 0.25; length of aperture of same, 0.1; diameter of oral, i. e., ventral sucker, 0.076; depth of same, 0.101; longer diameter of ova, 0.017; shorter diameter of ova, 0.01.

The vitellaria, seen from the side, form a cluster of subglobular bodies placed dorsally on a level with the space between the acetabulum and mouth. The cirrus and cirrus-pouch are median in position, extending from near the middle of the body to the posterior end. Testes and ovary could not be seen distinctly on account of the voluminous uterus crowded with ova; so far as could be made out, they appear to lie on the right side, having about the same position as in *G. oratum*.

*Calyptribothrium occidentale* sp. nov.

[Plate 41, figs. 62-67, U. S. N. M. No. 6526.]

One large and six small cestodes from the intestine of the torpedo (*Tetranarce occidentalis*) July 25, and two small specimens from the same host on July 26, are here included.

The genus *Calyptribothrium* was erected by Monticelli (*C. riggi*, *Naturalista Siciliana*, An. xii, 1881, p. 15, pl. 1, figs. 1-4) to accommodate a species found in *Torpedo marmorata*.

At the time of collecting I thought that the small specimens on the one hand and the large specimen on the other belonged to distinct species. After a careful comparison, however, I am led to the belief that they belong to the same species.

Synopsis of species: Head truncate, bothria four, in lateral pairs. Anterior end of bothria with horseshoe-shaped sucker, posterior end articulate; bothria prominent and retractile, or partly so, in small specimens, nearly sessile in large specimens on account of thickening of axial part of head; posterior part of head continuing into a subcylindrical neck, which is about as long as the head proper in the large specimen, but over three times as long in the small specimens. First segments remote from the head very short; strobile linear; posterior segments rectilinear (ripe segments not seen); reproductive cloner on lateral margins about middle of length of segments.

The following dimensions in millimeters were taken from alcoholic specimens. Diameter of head, lateral 1.95, marginal 1.76, length of bothridial portion 1.8, distance from anterior end to where neck begins to diminish 1, thickness of neck just back of bothria 1.4, distance to first distinct segment 1.50, breadth of first distinct segments 0.84, length of last segments 0.76, breadth 0.9, thickness 0.37, length of head and neck 6. Length of large specimen in life, 250 mm. Small specimens not measured in life. The longest preserved small specimens are 18 mm in length. A few measurements were made of the head of one in life, as follows. Breadth, bothria being extended nearly at right angles to axis 1.4, length of head proper, about 0.37, distance from anterior end to base of neck 1.33, diameter of neck just behind the bothria 0.46, diameter just before it begins to abruptly diminish 0.36, breadth just back of neck 0.21, length of posterior segments 0.42, breadth 0.65.

In the small specimens the first indication of segments, which appear as faint transverse indentations, is about 8 mm back of the head. The last segments are minute. In general proportions and shape they resemble the segments of the large specimen.

The principal difference between the large specimen and the small ones is in the appearance of the head rather than in any essential dissimilarity of the bothria. In both the bothria are in pairs and the pairs are on the sides of the head which correspond with the margins of the body. In the alcohol specimens the bothria are seen to be arranged in pairs, but the anterior parts are directed in opposite directions, so that the two anterior portions which are seen on the same side of the head really belong to different pairs of bothria (fig. 93).

In large and small specimens alike the interior part of a bothrium consists of a strong muscular nodule, shaped like a horseshoe, with the break in its border turned toward the posterior tip of the bothrium. The latter in the small specimens stands out as an uncurved appendage nearly at right angles to the axis of the body, while in the large specimens they are appressed. The neck in each case is thicker than the anterior part of the body, being, in fact nearly cylindrical for a short distance back of the head, where it diminishes in thickness, and, in the large specimen, also in breadth rather abruptly. This cylindrical neck in the large specimen, proportionally to the head and body, is much larger than in the small specimens. The enlargement appears to affect the axial part of head also, thus filling in the interbothridial spaces and making the bothria sessile instead of prominent, as in the smaller ones.

The genus *Monosigma* is suggested by this species, and indeed Monticelli places the genus *Calyptribothrium* in that genus. The head terminates abruptly without an ornament of any kind, which excludes the genus *Monosigma*. Again, the muscular auxiliary sucker on the front end of the bothria is of altogether different character from the auxiliary acetabulum of *Phyllobothrium*.

Sections were made of several of the posterior segments of the large specimen, and, while the segments are miniature the general arrangement of the reproductive organs could be made out. The cirrus-pouch is pyriform and lies near one of the lateral margins, where it opens near middle of the length of proglottis. Within the bulb lie several convolutions of the vas deferens. The retracted cirrus is minute and not fully developed. A granular apical mass on its walls suggested what might later develop into spines. The globular testicles occupy central portion of proglottis, mainly from a little behind the middle to anterior border. The vagina opens in front of the cirrus in a common genital cloaca. The vitelline glands are voluminous and lie along the lateral margins. The ovary was identified as a smallish, lobulated mass of nuclei lying near the posterior margin of the proglottis, and staining somewhat differently from the vitelline glands. All the organs were for the most part masses of nuclei, staining deeply in carmine and presenting few differences. In the center of the segments was a mass of nuclei, some of which appeared to be lying to the vitellina, and others forming the vas deferens and uterus. The latter, or what was so interpreted, appeared as a relatively large open space surrounded by a clustering mass of nuclei.

Sections of posterior segments from the small specimens show testicles already begun and the rudiment of a cirrus-pouch.

The neck, when sectioned, is seen to enlarge from the anterior part of the body by the expansion of the inner parenchyma, which consists of loosely intersecting fibers with wide meshes, through which the longitudinal vessels pass in strong strands. In the peripheral portions the longitudinal muscle fibers are very strongly developed. Nuclei are sparse in the central portion of the neck except in the vicinity of the spiral longitudinal vessels.

The most obvious difference between this species and Monticelli's species is in the character of the neck, in *C. signa* the neck merges imperceptibly into the body, while in *C. occidentalis* the neck is much thicker than the body and narrows rather abruptly a short distance back of the head.

*Platybothrium* sp.

[Plate 42, figs. 98, 99, U. S. N. M. No. 6527.]

On August 18, a single specimen of the genus *Platybothrium* was obtained from the spiral valve of the hammer-head shark (*Sphyrna zygaena*). As the genus with the previously-described species (*P. cerrium*) rests on a single specimen from the dusky shark (*Carcharias obscurus*), I shall not venture to bestow a specific name on this specimen until more material is available.

The head agrees with *P. cerrium*, particularly in the character of the hooks. There are, however, two costs on the posterior end of each bothrium, a character not clearly made out in *P. cerrium*. The greatest difference is in the size; whereas the length of the specimen upon which the species *P. cerrium* was founded was 67 mm., that of the specimen under consideration is only 3.55 mm. The neck in this specimen is densely beset with conical spines, which is not a character of the other. It is possible that this may be a character peculiar to young strobiles. The difference in hosts can hardly be considered as weighing against probable identity of species, as this specimen was associated with several representatives of *Phoreiobothrium lasium*, also first described from the dusky shark.

Head as in *P. cerrium*, broad, flat, and thin; bothria four, each armed with a pair of two-pronged antler-like hooks, connected with each other at the base by a short chitinous bar; bothria truncate in front, with two short costs behind. Neck spinose, slender, and of nearly uniform size for about 0.7 mm., then enlarging abruptly, thickened and somewhat fleshy, probably a contraction condition. Segments at first much broader than long, but increasing in length gradually; last segment longer than broad, with rounded ends, not mature, but appeared to be loosely attached.

Dimensions of living specimen in millimeters: Length 3.55, length of head 0.31, breadth of head 0.35, diameter of neck 0.06, distance to first segment 0.48, length of first segment 0.1, breadth of first segment 0.28, length of last segment 0.5, breadth of last segment 0.33, length of spines on neck 0.023, number of segments 6.

The spines are abundant on the neck, becoming sparse on the first segments and occurring only scatteringly on the lateral margins of other segments.

## Larval Cestode from the Bonito.

[Plate 42, fig. 100, U. S. N. M. No. 6528.]

Among the few ctenozoa found in the bonito (*Sarda sarda*) is a small blastocyst which was liberated from a cyst on the pyloric caeca. The length of the living specimen was 3 to 6 mil., depending on the state of contraction. When set free from the cyst it was very active, contracting and expanding and even making some headway in progression in a forward direction. There was a small aperture at each end, and along the central region were numerous roundish bodies. There is a well-marked constriction just back of the head in the alcoholic specimen, 0.13 mm. from the tip, whence it tapers to a blunt point. The mouth communicates with a short canal.

The following dimensions, in millimeters, are of the specimen mounted in balsam: Length about 4, breadth at anterior constriction 0.31, slightly broader than this a short way back of constriction, then narrowing to 0.18 at middle, expanding again to 0.34 near the posterior end.

Beginning just back of the constriction and continuing for about three-fourths of the length there are suspended in the middle of the body an elongated cluster of pyriform struetores, each about 0.035 in the longer and 0.028 in the shorter diameter. Each is attached by a slender stalk at the smaller end. I have recorded something similar to this in a larval *Rhynchobothrium* from the intestine of the sand shark (*Carcharias littoralis*). [Proceedings of the U. S. National Museum, vol. XIX, p. 797, pl. LXIII, figs. 14-16.] The walls of the body were very thickly set with nuclei.

The specimen was embedded and cut into longitudinal sections in the attempt to ascertain the nature of these pyriform bodies. Like the parenchyma generally they were scarcely at all stained by carmine. By transmitted light they appeared to be of a faint yellowish-brown color. No structure could be made out in these central bodies. While many of them are pyriform, this designation does not fit all of them. In sections the body wall is seen to be very thin.



On the Occurrence of Cysts in the Stomach Wall of *Pomatomus saltatrix*

(Plate 42, figs 101, 102, U S N M No 6529)

A piece of the stomach wall, about 8 mm square, comprising the mucosa and submucosa taken from the stomach of a blue fish July 23, was stained in borax carmine and sectioned.

One of these sections, measuring 8 mm in length, had passed through six distinct cysts, each containing, so far as it was possible to determine, a larva of *Tetrahynchus*. Some of the cysts contained embryos which were too young for certain identification. The combined length of these cysts was 35 mm. The superficial area included in the sections of these cysts represented two fifths of the area of the submucosa of the entire section. If this ratio of cysts and submucosa were maintained throughout the stomach of the fish it would follow that something like 12 per cent of the tissue of the stomach consists of foreign tissue it not actively inimical to life at least passively so. The amount of energy consumed in building up the protective cysts about these embryos, and of digested and absorbed food which is diverted to the use of these vagrants, must be considerable. The above is possibly somewhat above the average, although it may be below it, for it is a common thing to find the submucosa of the stomachs of blue fish, syntaenids, flounders, etc., so full of cysts that the space occupied by the cysts, as seen on superficial view, appears to be quite as much as the space remaining between the cysts.

The outside wall of each cyst consists of connective tissue fibers in concentric circles compact but merging in places into the connective tissue elements, with numerous nuclei. Within this is the cyst proper, the outer layer of which stains deeply in carmine and is made up of a few concentric, plate-like, structureless layers, which are somewhat brittle. Within this is the blastocyst. The outer layer of blastocyst and the closely underlying muscular elements stain moderately, but the enclosed parenchyma, which makes up the interior, stains very little. The embryo, on the other hand, stains quickly and strongly in carmine. The parenchyma in these sections is an opened meshwork of unstained tissue, with sparse nuclei scattered through it. Near the boundary the nuclei become abundant.

The above mentioned incubants were measured in one cyst with the following result, dimensions in millimeters: Thickness of outer nucleated connective tissue 0.02; of inner non nucleated layer 0.007; of outer layer of blastocyst 0.007.

## Cysts from Kidneys of Scup

(U S N M No 6530)

Small globular cysts were found in the kidneys of a scup (*Stenotomus chrysops*) August 1. These cysts were about 1.5 mm in diameter. Two of them were opened, but nothing could be made out of the contents. There were also small blotches of black pigment on the surface of the kidneys.

A few of these cysts were sectioned, with the following result. The cysts appear to be small tumors, 1 mm or less in diameter. They are composed entirely of connective tissue and are exceedingly compact. Toward the periphery of the tumor there is a concentric arrangement of the fibers which is quite distinct, portions showing a tendency to separate, or rather to become slightly loosened from the general mass. Though this concentric arrangement was traceable from the greater part of the periphery well toward the center, it was lost near the center, and at one side was indistinct. Nuclei were abundant throughout the mass. Only the tumors, with what tissues remained adherent to them on removal from kidneys, were preserved, but the sections disclose an abnormal condition of the adjacent tissues in that they are infiltrated with blood so as to resemble a blood clot with a few numerous tubules penetrating it. In this infiltrated tissue are also numerous small black pigment masses.

Such conditions call for further investigation to bring out the actual structure and the extent to which the tissues are affected. No nucleus could be distinguished in any of the tumors sectioned.

On Cysts in Stomach-wall of the Black Sea-bass (*Centropristea striatus*)

(Plate 42, figs 103, 104 U S N M No 6531)

A number of sections were made and mounted serially of a part of the stomach-wall of a black sea-bass, collected July 28. A study of these sections reveals the fact that some of these cysts are formed around blastocysts which contain larva. In a few cases they were developed far enough to show by the character of the hooks that they were now not identical with forms already described from this host. (Notes on Larval Cestode Parasites of Fishes, pp 793-794 pl II, fig 12.) Others are too young to admit of identification further than that they represent the early stage of some cestode worm, but presumably most if not all of them belong to the genus *Rhyachobothrium*, and possibly to a single species.



Fig. 143 is the sketch of a section through one of these small cysts; the longer diameter of the blastocyst is 0.19 mm., the shorter 0.15. The blastocyst is surrounded by a fine granular coat, 0.007 mm. thick, with a few refractive bodies. This coat in turn is closely invested with a thin covering of connective tissue 0.003 mm. thick. Concentric layers of connective tissue arranged somewhat loosely lie outside of this and are very abundantly supplied with nuclei. The latter layer is about 0.038 mm. thick where the layers are most crowded, and 0.055 mm. where more open. Outside the concentric nucleated area the connective tissue is normal, with few nuclei. These cysts lie in the submucosa.

*Ascaris clavata* Rudolphi.

[Plate 43, figs. 105-108, U. S. N. M. No. 6532.]

About 50 specimens were collected July 14 from the stomach of a pollock (*Pollachius virens*) by Prof. H. M. Kelly. I have obtained this species frequently in former years from the cod and twice from the pollock, although my notes on the species have never been published. Diesing's synopsis of the species is:

"Head with two linear posteriorly decurrent alae; mouth with large rounded lips. Body anteriorly very much attenuated, moderately inflected; caudal extremity of the male inflected with mucronate tip; copulatory spines arcuate."

The following characters adapted from von Linstow's description are added, being in close agreement with what I observe in these specimens: Head and tail ends inflected. Upper lip extended, the pulp cylindrical, somewhat narrowed in the middle, two roundish projections on the inner side. The anterior border and the base of the upper lip are of equal size and equal to half of the greatest breadth. The two papillae are small and situated far toward the front. The oesophagus measures one-fourteenth of the body length. The intestine continues in front, where it springs from the oesophagus into a caecum 1.8 mm. in length and lying beside the oesophagus, while the latter likewise continues posteriorly in a caecum which lies beside the intestine and is of equal length with the first caecum, but only half as broad. The male is 45 mm. long (see below) and 1 mm. broad, the tail measuring  $\frac{1}{10}$  of the body length; the tail end is sharpened to a point, its extreme end being beset with little brilliant elevations; the cirri measure 2.2 mm. and are thus relatively long. There appear to be 27 preanal and 6 postanal papillae. The female has a length of 70 and a breadth of 1.3 mm.; the tail is bluntly conical, with somewhat diminished tip; it equals  $\frac{1}{10}$  of the body length.

The foregoing description agrees well with the individuals under consideration, except that 1 and the length of my specimens falls short of the dimensions given by von Linstow. The largest females measured 60 and the largest males 10 mm. in length.

In one specimen, a male, examined with some care, the oesophagus was about one-tenth of the body length. The cephalad prolongation of the intestine at its juncture with the oesophagus was seen distinctly; the caudad prolongation of the oesophagus was also made out, but less clearly. The character of the cirri is exactly that given by von Linstow. The upper lip presents some differences from the above description, the pulp being somewhat clavate in shape and relatively broader near the anterior end than indicated in von Linstow's figure and description. The lip is also relatively shorter and broader. The papillae were not studied very closely in this lot, but so far as they could be determined in a specimen seen in lateral view, they agreed in number and position with published descriptions of the species.

*Ascaris habena* sp. nov.

[Plate 43, figs. 109-115, U. S. N. M. No. 6533.]

On September 5, eight nematodes were obtained from stomach and intestines of two specimens of tom-cod (*Ophiodon* *lat.*). I have seen this species often in previous years at Woods Hole, in this host.

Body tapering gracefully from near the posterior to the anterior end; jaws prominent, each with lateral membranes and two papillae, rhomboidal but rounded apically with four horny teeth. Tail somewhat variable in preserved specimens, short conical or even truncate, sometimes mucronate at tip, that of males shorter than females. Minute lateral wings are present at anterior end, though they were not noticed until transverse sections were made. The cuticle generally is smooth, but transverse striae, 0.01 mm. apart, were noticed near the posterior end in one case. The posterior end exhibits a strong tendency to curve ventrally in the females as well as in the males. In fact, more success was had in straightening the males than the females in the killing fluid. The greatest diameter, especially in the case of the females, is near the posterior end.

In a female measuring 30 mm in length the oesophagus was 6 mm in length.

The anal papilla in a male was made out to have the following arrangement. There are 26 papillae on each side, 21 preanal and 5 postanal. The postanal papillae are very small. The posterior preanal papillae are also very small. These are preceded by 1 of medium size, and these again by 16 large, prominent papillae. While the number appears to be the same on the two sides, those on right side extend a little farther toward the middle than those on left. The spicules not made out clearly.

Dimensions in millimeters of alcoholic specimen in acetic acid, side view.

(1) Of a male, length 29, length of head 0.11, diameter of head 0.14, diameter 5 mm back of head 0.26, diameter at middle of body length 0.66, diameter 5 mm from posterior end 0.77, diameter at anal aperture 0.14, length of tail 0.07.

(2) Of a female, length 32, length of head 0.22, diameter of head 0.22, diameter 5 mm back of head 0.16, diameter at middle of body length 0.45, diameter 5 mm from the posterior end 1.5, diameter at anal aperture 0.33, length of tail, 0.35.

#### *Acanthochoilus midifex* sp. nov.

[Plate 44, figs. 116-119 U. S. N. 21,651.]

On August 11 and 19, large nematodes, with minute, inconspicuous jaws, were found in the stomach-wall of the tiger shark (*Galeorhinus tigris*), which appears to belong to an undescribed species. The body tapers from a short distance in front of the middle to the anterior end, while it is of nearly uniform size from the middle to near the posterior end, plump and smooth, the cuticle closed by faint transverse striae. Head minute, three-lobed. Since in some cases three small lobes could be seen distinctly, while in others the three-lobed character of the mouth is not so plainly shown, it would appear that the worm has the power of retracting these oral lobes. Two minute conical papillae, with their points directed forward, could be made out on one of the lobes of a small specimen. A large specimen, when viewed from the ventral side in acetic acid showed two papillae plainly on each of the lateral lobes. The aperture of the mouth is very minute and is turned a little toward the ventral side. The tail is rather slender conical, and about equals in length the diameter of body at anal aperture. Tips of anal aperture in large females rather prominently rounded.

The anal papillae were not made out with entire satisfaction. A specimen was prepared in the following way. After stitching, the dorsal portion of the posterior end was cut away and the ventral portion spread out on a slide, ventral side uppermost, and mounted in balsam. In some way the postanal part was lost, so that only the preanal papillae are shown. These are arranged in a double row on each side of the median line. On the left side the arrangements are regular, and eight pairs, or sixteen single papillae, were counted. On the right side, while about the same number of papillae were counted, they were not arranged so regularly as on the left side. They were, however, in two rows, as on the left side. The walls of the intestine are much folded, especially toward the posterior end. A branch of the intestine extends forward from the base of the oesophagus and lies beside that organ. The thickness of the cuticle is about 0.05 mm. The ova, with which the uterus of the specimen sectioned was crowded, were 0.01 mm in diameter, with a transparent, non-staining envelope, surrounding a minute mass which stains strongly in alum carmalum, the diameter of this mass is about 0.025 mm.

Dimensions of a large female (alcoholic) in millimeters. Length 125, diameter of head 0.21, greatest diameter of body 2.5, diameter at anus 0.78, length of tail, 0.78. In another of the same length the diameter in front of the anus was 0.57 and the length of the tail 0.61. In a small specimen, also a female, 35 mm in length, the length of the oesophagus was 1 mm.

These worms occur in cysts or nests, for the most part in the submucosa of the stomach. In the lot collected August 11 they were first noticed as hard cyst-like places in the stomach wall. When these were cut into the worms were liberated. There appeared to be a male and female, at least a large and a small worm, together in most cases. Two of the cysts were lined with a continuation of the stomach epithelium, which had apparently closed over the point of entrance from the interior of the stomach. In one case the worms lay between the two muscular coats of the stomach wall. One small specimen was free in the stomach, and one large one was found along with the viscera, but since the head of the shark had been cut off before I examined it for worms, these nematodes may have been liberated by the dissection, the place of which passed through the anterior end of the stomach. The specimens were not enclosed in cysts of connective tissue.

In the shark examined on August 19 my attention was attracted to these worms by noticing in the mucous membrane of the stomach which had been carefully washed, that there were a few worm-

tales protruding their heads two or three centimeters from the mucous membrane, into which they would rapidly withdraw when touched. It was then noticed that they were in the vicinity of swollen masses, apparently cysts in the stomach wall. An examination of one of these revealed a large nematode coiled up in this living nest, not encysted, but able to leave the nest whenever occasion demanded. The mucous membrane was dissected away from one of these worms, showing that it was coiled up in the submucosa (fig. 116). Around it, for a space some 3 cm. square, the tissues were highly inflamed and filled with extravasated blood. This was also observed in at least one of these cavities, occupied by a nematode.

Although the worms are not completely encysted there is evidently a considerable accumulation of connective tissues in the submucosa in the vicinity of these nests. Communication seems to be maintained by the worm between the crypt and the lumen of the stomach.

This habit of making a nest for itself in the stomach wall of its host is certainly an unusual one, and for the comfort of a growling and travelling creature it is to be hoped that there are few parallel cases in nature.

#### *Ichthyonema sanguineum* Rudolphi (?).

[Plate 43, figs. 120-121, U. S. N. M. No. 6533.]

A single example of a blood-red nematode from the inside of the cheek of a flounder (*Paralichthys dentatus*), where it was partly embedded, appears to be near to or identical with *Ichthyonema sanguineum*. The flesh of the host was much inflamed in the vicinity of the worm. The specimen proved to be a female and was crowded with young. The latter are very minute, one end blunt, the other exceedingly attenuate. I have not examined the young of this genus with great care, although I have collected them at different times. In my notes I find that I have been calling the attenuate end the anterior, but since this is contrary to authorities on this subject I have probably been in error. My notes made at the time of collecting would appear to state that the progressive motion of these worms is in the direction of the smaller end.

The body of the adult is linear and narrows rather abruptly at the anterior end. The head bears four broad lobes or flat surfaces, each of which carries two papillae. The esophagus, at first slender, enlarges gradually to a point a little behind the middle of its length, whence it maintains about the same diameter to its rounded base. The intestine at its beginning is but little larger in diameter than the esophagus. A slender anterior portion of the ovary is seen lying beside and across the esophagus. The uterus is very spacious. The sections of the anterior end which were made show considerable variation in the relative dimensions of uterus and intestine. In most of the sections the uterus occupies far the greater part of the body cavity, and is filled with the young, of which there is an immense number. Near the posterior end the diameter increases and the posterior end is bluntly rounded.

The following dimensions, in millimeters, are of the preserved specimen: Length 30; diameter of head 0.23; length of esophagus 1.14; diameter of esophagus, anterior 0.1, posterior 0.17; greatest diameter (specimen somewhat flattened) 1; diameter near posterior end 0.85.

#### EXPLANATION OF PLATES.

a. Acetabulum.

c. Cirrus.

e. Ova.

ep. Cirrus pouch.

ex. Excretory vessel.

g. Genital aperture.

i. Intestine.

o. Ovary.

p. Prostate gland.

ph. Pharynx.

sr. Seminal receptacle.

st. Seminal vesicle.

t. Testis.

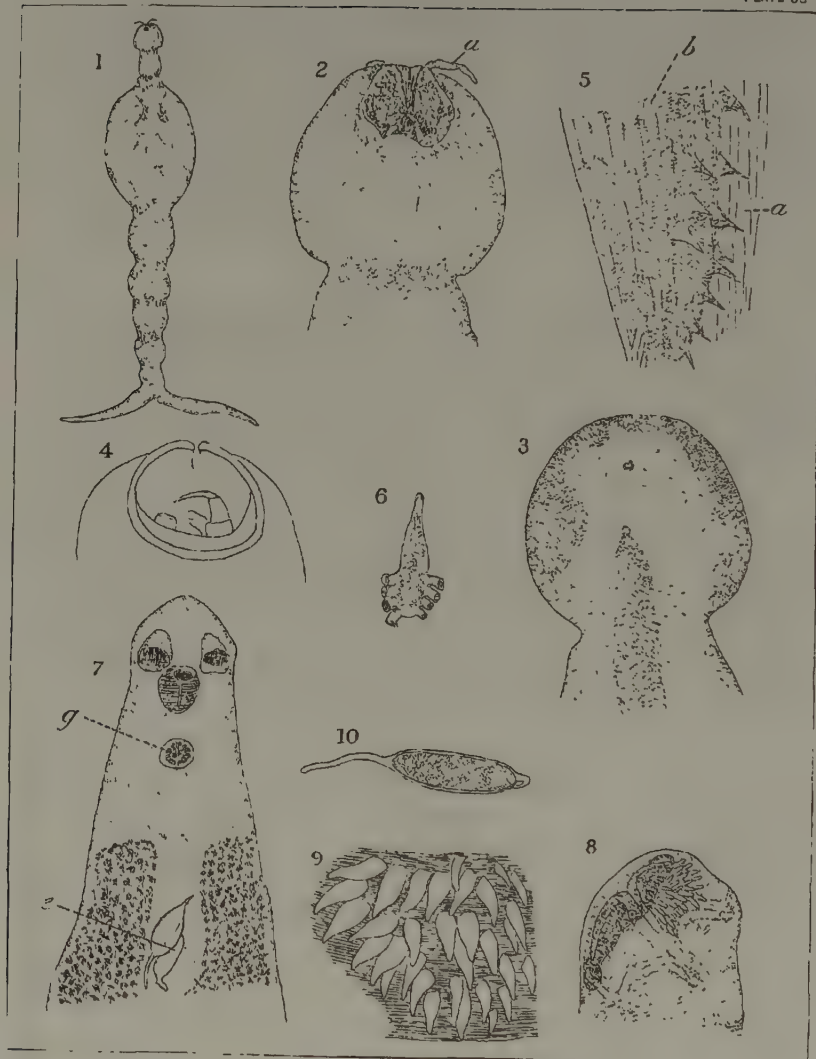
u. Uterus.

vd. Vas deferens.

vg. Vitelline gland.

vd. Vitelline duct.

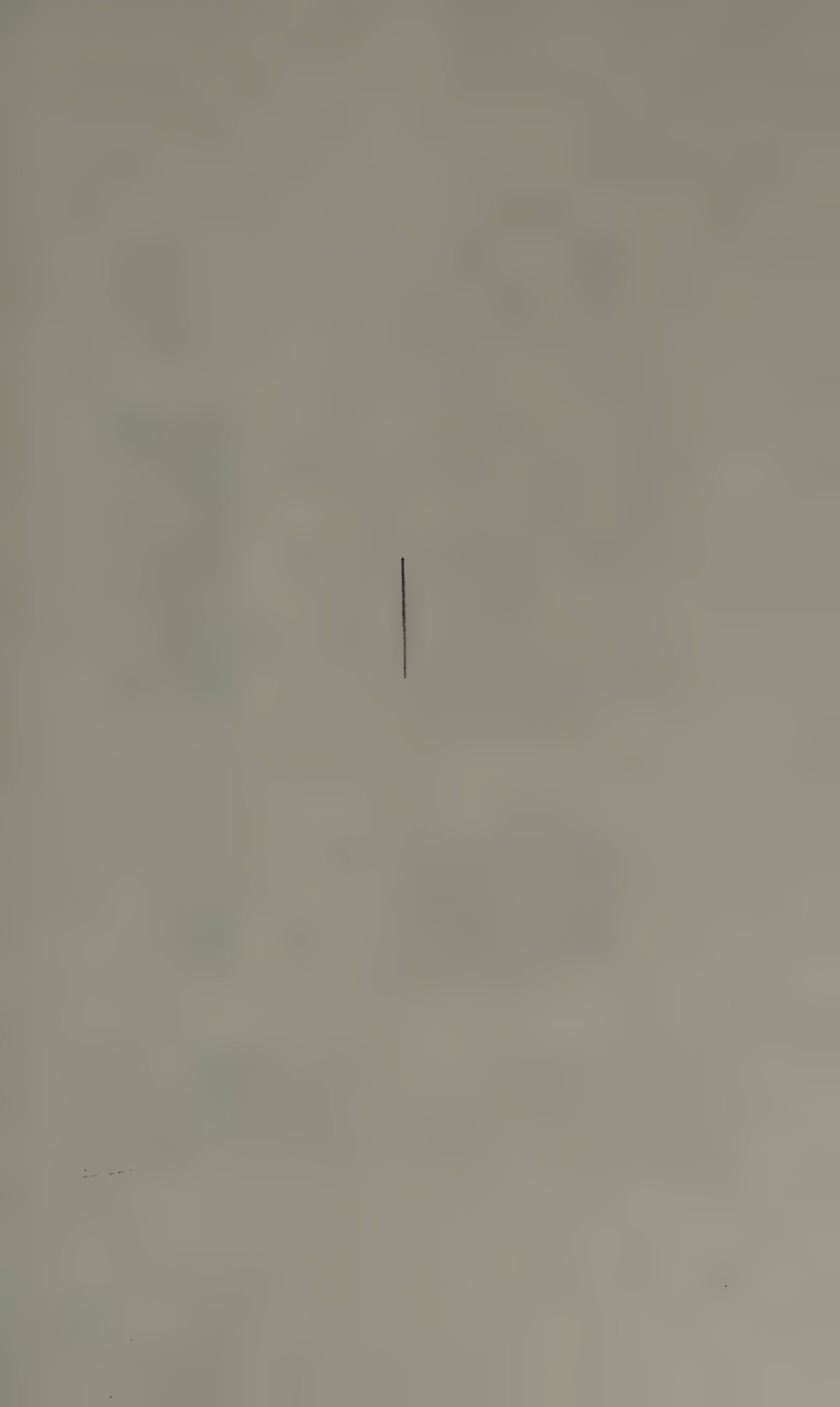
The figures have been reduced about one-fifth.

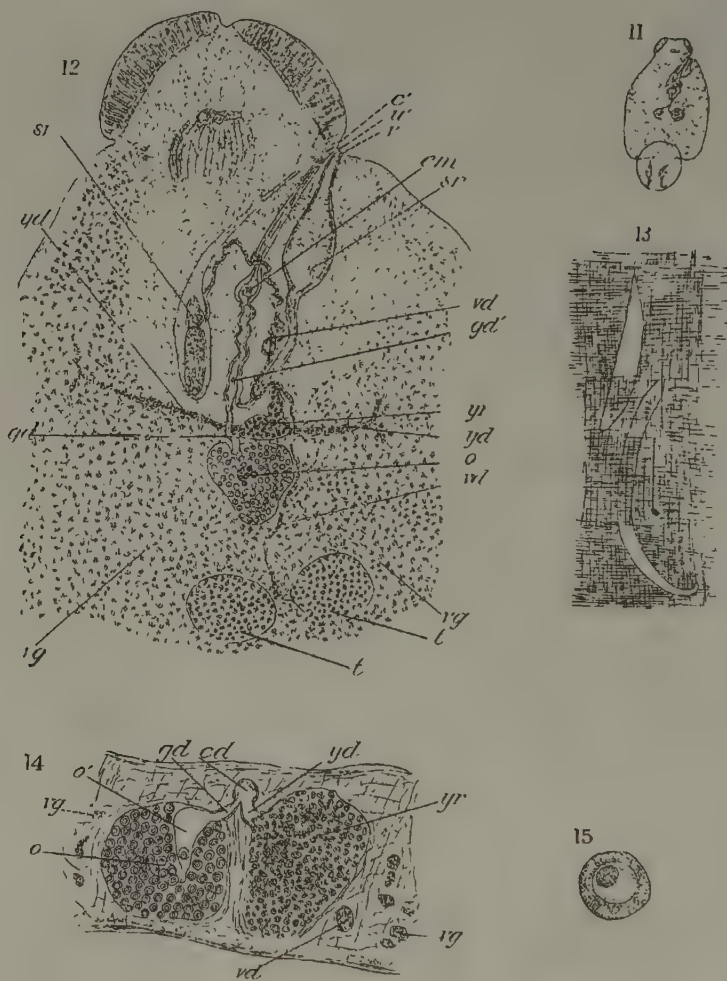
*Parasitae captured from Quercus repens*

- 1 Dorsal view of quercus showing the minute antenna and the single eye from life.  $\times 8$
- 2 Ventral view of head from life.  $\times 15$
- 3 Dorsal view of head from life.  $\times 15$
- 4 Ventral view from glycerin mount.  $\times 100$
- 5 The right maxilla broken, its basal joint alone remaining.  $\times 100$
- 6 Portion of one of the trid folds.  $\times 100$
- 7 Chitinous tunic.  $\times 100$
- 8 Detail of the right maxilla broken, its basal joint alone remaining.  $\times 100$
- 9 Portion of one of the trid folds.  $\times 100$
- 10 Chitinous tunic.  $\times 100$

*Oribodhryum dentrolatens from Poliochilus virens gillette*

- 1 Ventral view, alcohol specimen.  $\times 1$
- 2 Ventral view of interior end.  $\times 10$
- 3 One of the posterior suckers showing chitinous hooks and patch of papillae.  $\times 60$
- 4 Papillae more highly magnified.  $\times 200$
- 5 Ovary sketched as it lay in the uterus, one of the mammary corpuscles in part.  $\times 170$





*Epobrella haupaiensis* sp. nov. from the exterior of *Desmantis reclinata*

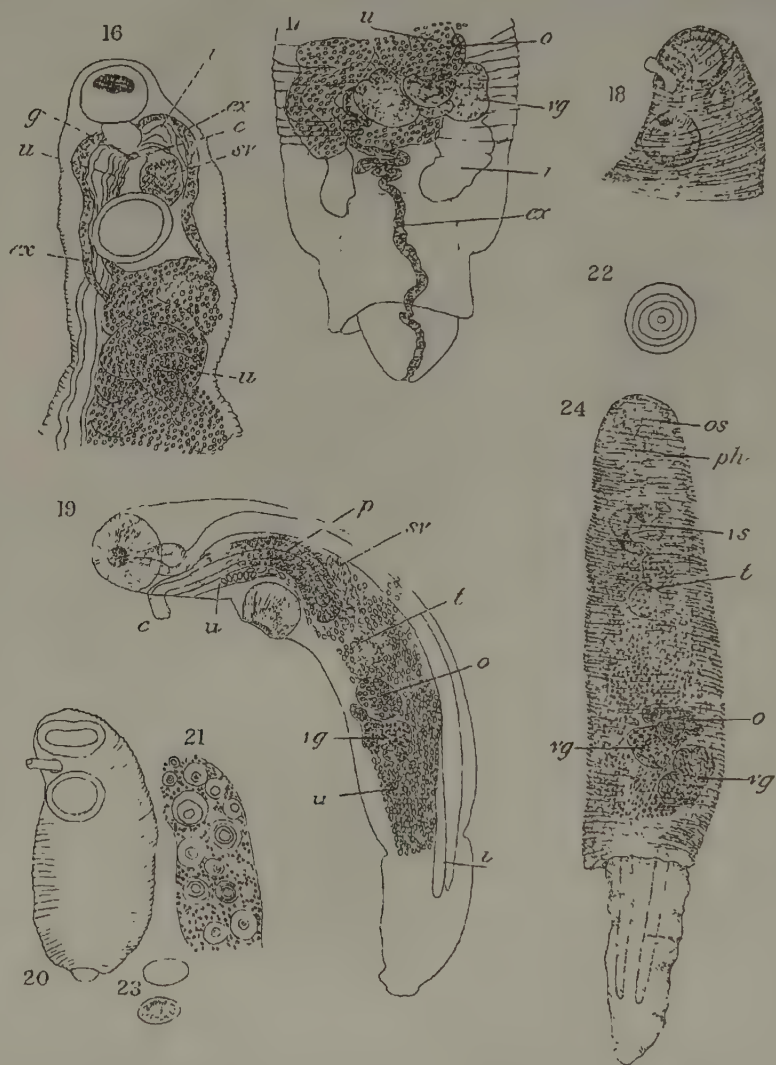
11. Ventral view of specimen mounted in balsam.  
 12. Ventral view of anterior part of same showing the uterus and its contents at the point where it is joined by the short duct from the yolk reservoir.  
 13. A pair of hooks from the posterior sucker.  
 14. Transverse section through the ovary and yolk reservoir.  
 15. Germ duct of the point where it is joined by the short duct from the yolk reservoir.

The line *sl* touches the seminal vesicle at a point where a faint pulsation was observed, which still continued in a specimen which had been living in seawater for twelve hours, most of the time under a coverglass.

The line from *o* indicates a part of the ovary in which the germ cells were first to move and were always thrown into a state of oscillation by the rush of yolk from the reservoir, *o* which preceded the formation of each egg.







*Distaplia nuttallii* from *Polysiphonia* colonies and *Metastacis*

16. Anterior end, ventral view, from life, somewhat compressed.  $\times 68$   
 17. Posterior end of same specimen, ventral view, from life, somewhat compressed.  $\times 68$   
 18. Smaller specimen, from life, anterior view.  $\times 100$   
 19. Small specimen in glycerine, side view.

20. Small specimen, from life, ventral view.  $\times 100$   
 21. Portion of excretory vessel with ciliary masses from life.  $\times 100$   
 22. Single ciliated cell.  $\times 70$   
 23. Ova.  $\times 100$   
 24. Alcoholic specimen in glycerine, side view.  $\times 100$   
 Nos. 16 to 23 from *Metastacis bilinearis*  
 No. 24 from *Polysiphonia* colonies



*Distomum appaetianum* from *Paratrichia dentatus*

25 Anterior end, lateral view 300

26 Ovary and vitelline glands of same 300

*Distomum foventium* sp. nov. from *Lophodolichus ephemerus*27 Lateral and ventral views, alcoholic specimen  $\times 1$ 28 Diagrammatic ventral view, restored from sections  $\times 25$ 

29 The voluminous vitelline follicle have been omitted

30 Left and right excretory vessel

31 Aperture of acetabulum

32 Transverse section through oral sucker 70

33 Detail of same  $\times 250$ 

34 Transverse section through acetabulum about the middle of its lumen. The branches of the intestine contain granular food.

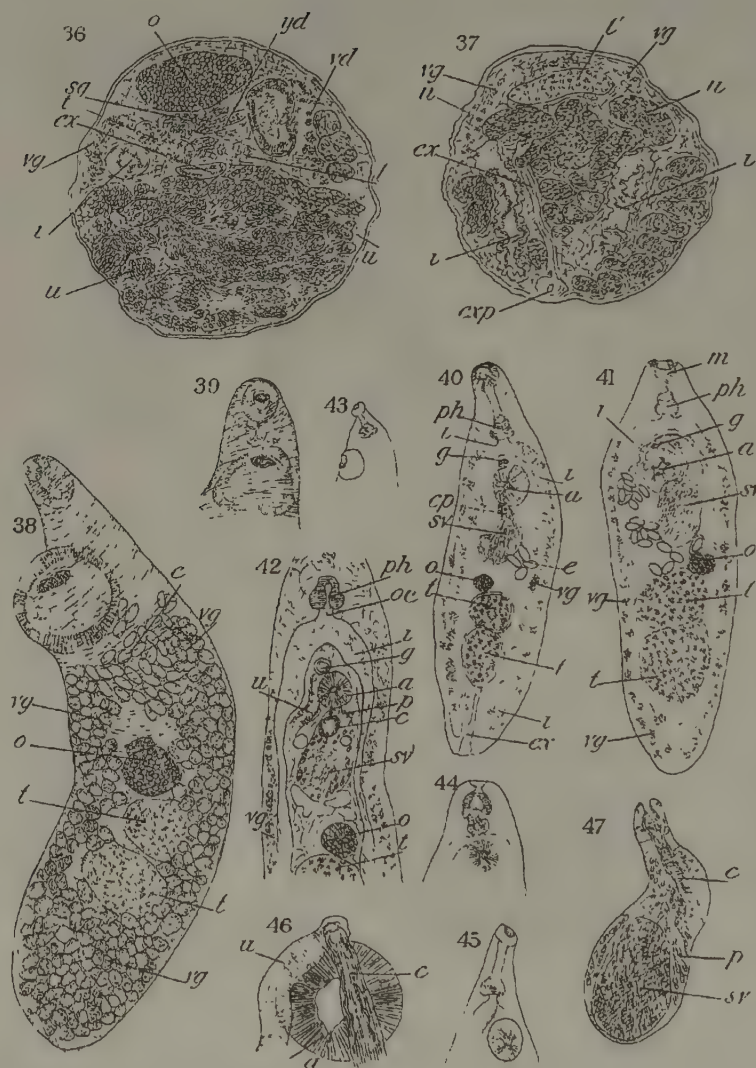
35 Transverse section between acetabulum and ovary  $\times 70$ 36 Wall of excretory vessel near posterior end  $\times 250$ 37 Wall of intestine at posterior end  $\times 30$ 

(See fig. 37)

38 Ovary  $\times 150$







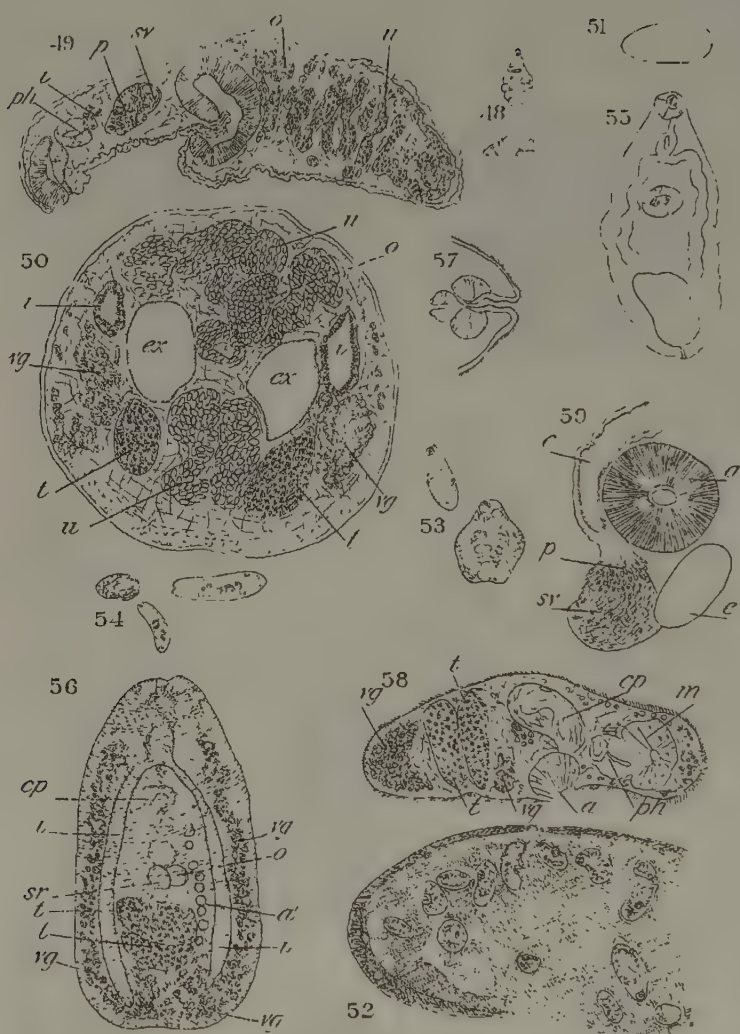
*Protonotus furcatus* (n. sp.) from *Enphelotus* cf. *eleutheros*. Continued.

- 80 Transverse section through ovary and testes. 70  
81 Shell gland. Right testis. 71 Beginning of left testis.  
82 Section behind ovary. 72  
83 Section of intestine. 73  
84 Section of intestine. 74  
85 Section of intestine. 75  
86 Section of intestine. 76  
87 Section of intestine. 77  
88 Section of intestine. 78  
89 Section of intestine. 79  
90 Section of intestine. 80

*Protonotus patens* sp. nov. from *Paralichthys dentatus*.

- 40 Longitudinal horizontal section of a specimen measuring 1.25 mm in length.  
41 Longitudinal horizontal section of a specimen measuring 1.15 mm in length.  
42 Anterior sucker (enlarged).  
43 Middle part of longitudinal horizontal section of another specimen.  
44 Section of intestine and 70

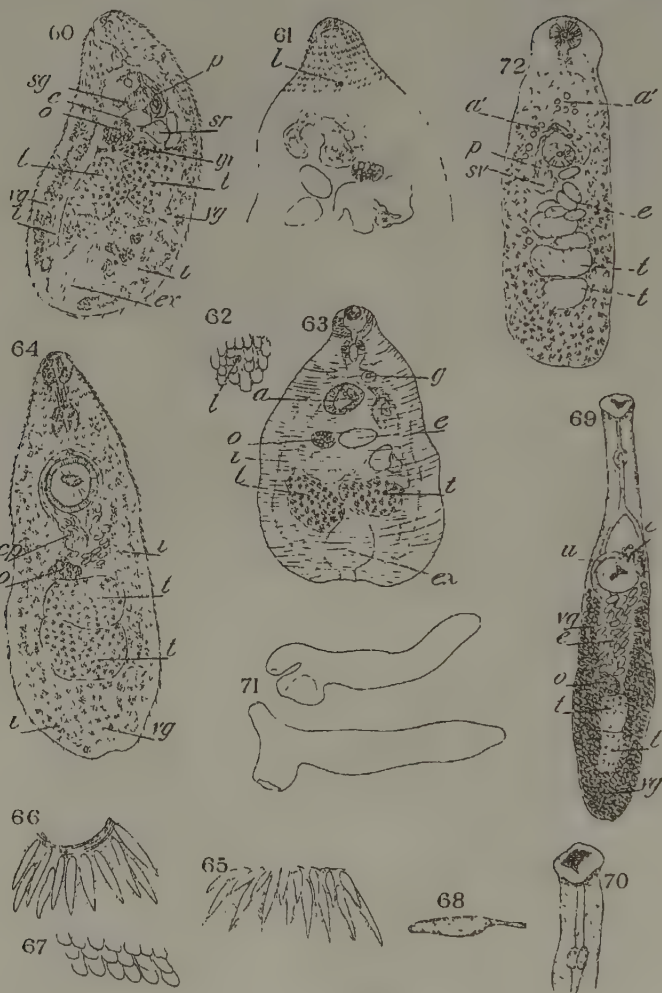




*Tardigrada* (Sphindus) sp. nov. from *Sphindus* (Sphindus) *sp. nov.*  
 49. Ventral and lateral views of an adult specimen. *× 40*  
 50. Median longitudinal vertical section. *× 20*  
 51. Transverse section through oesophagus and testes. *× 50*  
 52. *Tardigrada* (Sphindus) sp. nov. from *Sphindus* (Sphindus) *sp. nov.*  
 53. Portion of section of pyloric caeca with distal end. *× 40*  
 54. Specimens showing some detail of form. *× 40*

55. Specimen with large circular secretory vessel. *× 40*  
 56. Dorsal view. *× 40*  
 57. Sectional view of the (2) of sphindus with concentric structure. *× 40*  
 58. Longitudinal horizontal section of the (2) of sphindus showing myoepithelial cells. *× 40*  
 59. Median longitudinal vertical section. *× 40*  
 60. Sectional view of the (2) of sphindus and ovum. *× 40*

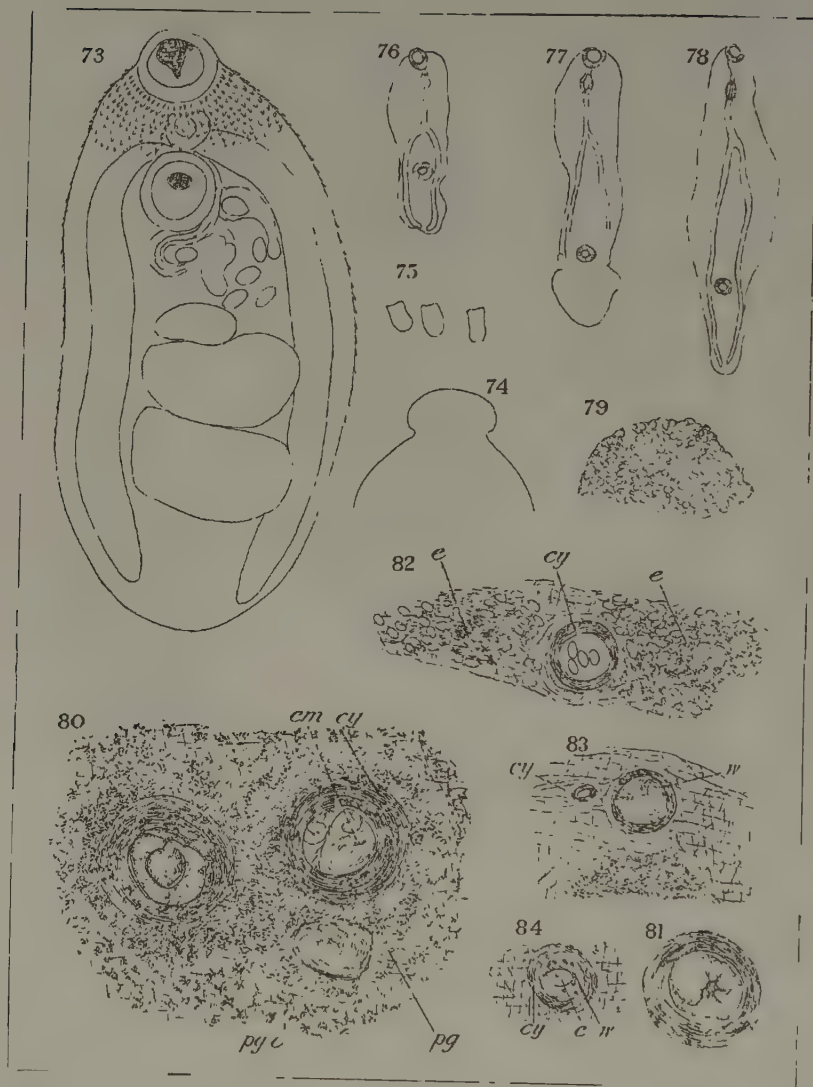




- Dendromyces* *arabidensis* sp. nov. from *Marine* *maritima*
- 60 Ventral view  $\times 70$
- 61 Dorsal view of anterior portion life spines not shown except in front of opening of *Limulus* and
- 62 Spines and opening of *Limulus* in life 100
- 63 Ventral view life spine not shown 100
- Dendromyces* *thalassius* sp. nov. from *Limulus* *thalassius*
- 64 Ventral view life sketch made after the specimen had been lying under the cover glass for some time 100
- 65 Dorsal view of end spines 400
- 66 Ventral view of end spines  $\times 100$
- 67 Pin-like spines of body  $\times 100$
- Dendromyces* *fragilis* sp. nov. from *Volva* *maritima*
- 68 Lateral view alcohol 20
- 69 Ventral view sketch of specimen in alcohol of thymus 100
- 70 Ventral view of anterior end 100
- Dendromyces* sp. from *Presmodus* *capitatus*
- 71 Outlines of two specimens life  $\times$  about 50
- Dendromyces* sp. from *Stomatopoda* *chequaga*
- 72 Ventral view life spines not shown  $\times 45$
- a spherical bodies with concentric structure







*Diatomium* sp. from *Paratubithys dentatus*

- 76 Ventral view. 100  
77 Outline of anterior end (dorsal view). 100  
78 Three like spines from body. 100

*Immature* distal end (cyst) in distal of *Paratubithys dentatus*

- 79 77-78 outlines of three individuals. 100  
79 Anterior end (dorsal view) sketch showing irregularly papillous structure.  $\times 100$   
80 Cysts with young distal end (optical section).  $\times 100$   
em. Young distal end. cy. connective tissue cyst. pg. mass of pigment accumulated about cyst. pgc. pigment cells.

- 81 Single cyst (optical section).  $\times 100$

*Immature* distal end from *Paratubithys dentatus*

- 82 Cyst and pigment from cross-section of cyst.  $\times 40$   
cy. connective tissue cyst containing cyst.  $\times 40$  with accumulation of pigment  
83 Cysts from same.  $\times 40$   
cy. cyst formed from single cyst.  $\times 40$  cyst containing wax section  
84 Single cyst from same.  $\times 100$   
cy. cyst.  $\times 40$  wax section of connective tissue cyst



*Cassirustomum arcuatum* sp. nov. from S. 1 det. Smith

- 53 Enterolobus cf. *sp.* from 70 m Month  
54 Enterolobus cf. *sp.* from 70 m Month  
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97 Enterolobus cf. *sp.* from 70 m Month  
98 Enterolobus cf. *sp.* from 70 m Month  
99 Enterolobus cf. *sp.* from 70 m Month  
100 Enterolobus cf. *sp.* from 70 m Month

*Chrysomelidae* in a minute sp. from Tennessee, etc.

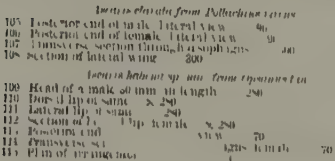
- 92 Head of male and small specimen of *Leptocryptus californicus* 18  
93 Front view of male thorax of *Leptocryptus californicus* 21  
94 Head of large specimen of *Leptocryptus californicus* 24  
95 Single bothrium of large specimen of *Leptocryptus californicus* 26  
96 Posterior segments of small specimen of *Leptocryptus californicus* 28  
97. In successive section of one of the posterior segments of large specimen of *Leptocryptus californicus* 30  
98 Length of longitudinal vessel 31











*Leptothorax maculatus* sp. nov. from *Chilodactylus longirostris*

136 Adult worm living in cyst in silhouettes on stomach wall about  
137 1 mm in size. *Color* yellowish-red. *Sex* male. *Size* 2.5 mm.

138 *General view of mouth* *Fig. 239*

139 *Lower lip*

140 *Length of anal or small intestine* *mm*

141 *Central view of cyst* *mm*

*Leptothorax maculatus* sp. nov. from *Streblospio benedicti* sp. nov.

142 *Head* *mm*

143 *Anterior section of body* *mm*

144 *Anterior view of lateral eye* *mm* *apophyses* *mm* *apophyses* *mm* *apophyses* *mm*

3

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